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Popular Mechanics®

VOLUME 160 NUMBER 2

AUGUST 1983

INTERNATIONAL EDITIONS: CARIBBEAN, MEXICO, SOUTHERN HEMISPHERE



ON THE COVER

The ParaPlane, test-piloted by PM Outdoors Editor Ray Hill, is the latest in ultrasimple, ultrasafe ultralight flying. Read about this exciting new license-free sport in the story beginning on page 66
—PM photo by Howard Levy

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Editor-In-Chief: John A. Linkletter
Executive Editor: Joe Oldham
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Design Director: Ira Herlick

Special Editorial Features: Sheldon M. Gallager, editor
Automotive: Michael Lamm (West Coast); Gary Wizenburg (Detroit)

Home and Shop: Harry Wicks, editor; Penelope Spangler, Michael Chabner, Joseph Thru, assistants

Boating, Outdoors and Travel: Ray Hill, editor

Electronics: Neil L. Shapiro, editor

Science: Dennis Eskow, editor

Editorial Production: Peter Easton, chief; John Bostonian Jr., art; Peter Francesconi, John Ginsberg, assistants

Art: Don Mannes, technical art director; Douglas Quinn, Alan Andersen, assistants

Special Publications: Clifford B. Hicks

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Reader Service Department: Hilde vonThorak, director; 224 West 57th St., New York, N.Y. 10019; (212) 262-4292

Advertising Manager: Frank P. Camastro

Advertising Offices:

New York: 224 West 57th St., New York, N.Y. 10019; (212) 262-8824

Chicago: 520 North Michigan Ave., Chicago, Ill. 60611; (312) 527-2400

Detroit: 377 Fisher Rd., Grosse Pointe, Mich. 48230; (313) 881-3520

Cleveland: POC Building, 3659 Green Rd., Cleveland, Ohio 44122; (216) 292-7334

Los Angeles: 440 East Carson Plaza Dr., Carson, Calif. 90746; (213) 532-8101

Production Manager: Ronald Tuosto

Advertising Production: Patricia Woods; (212) 262-4800

Classified Sales Manager: Sophie Gronowicz; (212) 262-4825

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EDITOR'S NOTES

John A. Lillington

When the "last American convertible" rolled off the Cadillac assembly line back in 1976, it appeared that an era had passed. No more ragtops from U.S. manufacturers! It almost seemed like heresy.

But the dream of driving with the top down in the sunshine never died among car buyers. They found other ways to get open-top cars. Specialists came along who could alter a standard car and turn it out as a beautiful convertible. The demand kept growing, so now all three of America's major manufacturers offer convertibles once again. And owners love 'em, as West Coast Editor Michael Lamm reports on page 58. To get the photos for the article required a convertible of sorts on our part. We built a wood structure on the bed of a pickup so our photographer could get high-angle shots as the cars were moving (on an airport runway, as a matter of fact). The photos are great, but the ride... well, we'll take a real convertible any time. . . . **Are you afraid of computers?** We're certain that many readers would like to join the computer generation, but are intimidated by all that talk about ROM, RAM, bytes and the like. You have help in this issue. Beginning on page 83 is PM's new Computer Guide. And even if you're already a user, look on page 92 for PM's home computer center you can build yourself.



Lots of wind-in-the-hair riding for convertibles shooting.



Even commuting to the office can be an outdoors activity, claims PM's Ray Hill.

Rarely has a newcomer to our staff made such a grand entrance as our new Boating and Outdoors Editor. The first time we've shown Ray Hill's picture is this month—smack on the cover. With his only piloting experience being a bit of hot-air ballooning, Ray volunteered to fly the new Para-Plane for the story that begins on page 66. (And, yes, he really did learn to fly in 15 minutes!)

Not that any of the foregoing is out of character. Ray is anything but an armchair sportsman. He's a white-water canoeist, rock climber, skydiver, backpacker, boater, RV camper—and motorcycle road racer.

You can look forward to lots more outdoor action in future issues. **PM**

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RUST BEATER® WINS THE SALT SPRAY TEST. You wouldn't deliberately expose any paint to 200 hours of tortuously corrosive salt spray. But we did. The results? Half the competitor's top coat and primer samples blistered. But Rust Beater® Acrylic samples were unaffected.

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LETTERS TO THE EDITOR



PM auto editors get a green light

Your auto editors really outdid themselves in your great *Car Care Guide* (page 111, May '83). I thought I knew something about cars, but your report on little-known things like braided-steel hose and silicone brake fluid really shook me up. I can't wait to try these on the \$38-an-hour mechanics we have here. Thanks for an outstanding job.

DAVID YOUNGER
LIGHTHOUSE POINT, FLA.

I've been reading columns like *Car*

Clinic in other magazines for years. But your replies to readers are the most professional and technically complete I've ever seen. It's good to know that there are still some people who take their work seriously and care enough to do a good job. Thanks.

FRED VOSHALL
ESSINGTON, PA.

I never write to magazines, but in your case I owe you such a debt of gratitude that I just had to let you know. I

bought a 1983 Honda Civic on your recommendation (*Imports And Motor-sports*, page 10, Feb. '83). You sure steered me right. The handling and acceleration are excellent, as you said, and I got 37 mpg even under the worst driving conditions last winter. Many thanks for your good advice.

STU BEEBE
ASHUELOT, N.H.

Managing Editor Bill Hartford replies: *Thanks for the kind words. We're glad to hear that our evaluation is borne out by your experience.*

Hairy Harrier tale

As an ex-U.S. Navy fighter pilot, I was extremely interested in your story by British Harrier pilot Lt. David Smith of the Royal Navy (*Falklands Diary Of A Harrier Pilot*, page 59, June '83). He's not only a red-hot pilot, but also a darn good storyteller. I was biting my nails before the end of the first page.

I was also pleased to see that the Roy al Navy is now using its own pilots. In the old days, I believe RAF pilots were assigned to the Fleet Air Arm, a rather awkward arrangement.

E.J. TONER JR.
LT. CMDR. USNR (RET.)
HOWELL, N.J.

New database software

I was very pleased to see your review of the computer database program dBase II (*PM Software Monitor*, page 62, May '83). It's all you said it is—and more. Not only is it compatible with all CP/M-capable computers, but it's also available for IBM's PC/DOS.

ANNETTE R. FLOYSTRUP
OAKLAND, CALIF.

PM's big-job yard cart

Thought you might like to see a photo of the garden cart I built from your plans (*Build This Garden Cart For The Big Jous*, page 123, June '82). I used fat-tired chopper bike wheels and reduced the length slightly to negotiate our steep terrain more easily.

We had been looking at carts of this type for some time, trying to figure out



PM's garden cart as slightly modified by reader Williams for use on hilly ground.

how to build one. Your excellent plans did the job. Total cost was about \$50, which represents a considerable saving over the \$200 commercial models we've seen—as well as a lot of personal satisfaction.

RICHARD WILLIAMS
AUBURN, CALIF.

I made the garden cart from your plans and it's great. Thanks.

FAY C. DRYDEN
SOUTH LONDON DERRY, VT.

Thank you both for letting us know. For others who may be interested, photocopies of the garden cart plans are available for \$1.50 postpaid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

GIs don't have fun

I was offended by the irresponsible statements made in your article on the new jeep (*The Jeep Is Dead, Long Live*

HMMWV! page 89, Apr. '83). Your references to "irreverent GIs" and "extra-curricular GI activities involving the opposite sex" were demeaning to members of the armed forces. Rarely will you find soldiers in combat seeking any of life's pleasures other than that of keeping themselves and their buddies alive.

Also, you misused the term GI. This acronym actually stands for government issue and is properly applied only to supplies, not people. I feel an apology is in order.

DANIEL I. EVANS, M. SGT., USAF
(NO ADDRESS GIVEN)

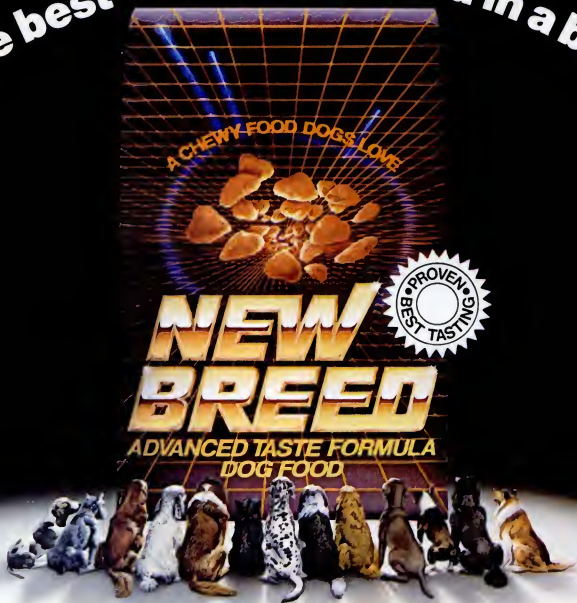
Our remarks were intended to be lighthearted, not deprecatory. If other members of the armed forces were offended, we'd appreciate hearing from them. The term GI, while it originally referred to government-issue equipment, has been affectionately applied to soldiers ever since World War II.

Saw for southpaws

In your Jan. '83 *Letters* column (page 6), you advised a reader that Skill makes a small portable circular saw designed for left-handed use. I'd like to point out that we also manufacture a similar left-handed saw. It's our Model 4200N trim saw and it has a 4 $\frac{1}{2}$ -inch blade.

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So while other dry dog food advertising might imply better taste, if you want the one that's proven best tasting, we've got a whole new breed.

Wagner[®] revolutionizes

Introducing the Wagner Power Twin™ airless sprayer/roller.

Imagine painting an entire wall and never once coating your roller in a paint tray.

Or tackling some intricate staining chore like shake shingles without the endless tedium of dabbing and poking with a brush.

Think about how nice it would be to never again have to pour paint from a can to a tray.

Now you're beginning to see the beauty of a versatile, new tool that stands to revolutionize painting around the house.

The Wagner® Power Twin™ airless spray/roller.

A Choice of Rolling or Spraying.

Created especially for home owners, the Wagner Power Twin is the first and only product of its kind.

It gives you the flexibility of an interchangeable spray gun and roller, both on a twenty-five foot hose.

The roller looks like the usual kind, but that's where the similarity ends. With this roller, a squeeze of the trigger pumps paint from the can, straight to the inside of the roller cover. Specially designed perforations distribute the paint evenly to the outside. So you can paint wall after wall nonstop, in smooth, even strokes. But

that's only half the story.

For covering large areas of hard-to-paint surfaces, you can attach the spray gun.

You'll be amazed how fast you can paint siding, shutters, decks, furniture, and more—all with a smooth, even finish and no brush marks.

The spray gun comes with a tough, tungsten carbide tip that lets you adjust the fan width of the spray for added precision.

And because it's powered by a piston pump, there's no bulky air compressor.

Applies Virtually All Kinds of Paint.

The Wagner Power Twin will spray oil-based paints and even heavy latex paints.

You can also apply stains, varnishes and lacquers. Or almost any other liquid, including sprayable pesticides.

Helpful Accessories.

A variety of accessories can help make painting with a Wagner Power Roller

even more convenient



2 hrs. 10 mins.

We painted this house, excluding trim, in 2 hrs. 10 minutes with the Wagner Power Twin. It took us 6 hours, 32 minutes with a brush.



24 mins.

We painted this porch floor and adjoining outside deck in just 24 minutes with the Power Twin. It took us 34 minutes (and 32 dunks!) with a conventional roller.

and efficient.

For painting the ceiling or for reaching the top of a wall, you can avoid using a ladder by adding an eighteen inch extension to the roller.

An optional spatter shield will make the job all but speckle free.

Power Twin roller covers are also available in four different naps to give you everything from a very fine finish on plaster, drywall and woodwork—to a more heavily textured finish on stucco, rough plaster and cinder blocks.

painting. Again.



30 mins.

We painted this bedroom, excluding trim in just 30 minutes with the Power Twin. It took us 57 minutes (and 81 dunks into the paint tray) with a conventional roller.



2 mins.

With the Power Twin, this porch swing took us only 2 minutes to paint. With a brush, it took 36 minutes.

For working outside, 12 and 24 inch spray tip extensions will let you paint overhangs without having to climb on scaffolding or up a ladder.

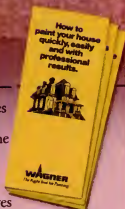
There's also a 25 foot hose extension that increases the total length to 50 feet. So you can easily reach the top of even a large two story house.

The Right Tool
for Painting™
Inside or Outside.
When you consider your

next painting project, whether it's the new baby room or the old shed out back, consider the incredible Wagner Power Twin.

It's the kind of blue chip investment that'll pay for itself over and over again in time savings, ease and professional-looking results.

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Where VWs come from

I've wanted to visit Osnabrück, W. Ger., ever since I learned that it was there that the Wilhelm Karmann company made the sporty version of the Beetle for Volkswagen. That was the Karmann Ghia, and it was only one body among many that this legendary coachbuilder has crafted for VW, Porsche, BMW and others.

Karmann currently is making the Scirocco and Rabbit convertible for VW. During my visit in May to see the pro-



Hottest Scirocco is the Wolfsburg Edition with racing body—for California only.

model I later had a chance to drive. It's the poshest Scirocco yet, and fast and smooth. Bodywork is IMSA-racer looking and the interior is leather.

After Karmann makes the body pieces unique to the convertible version of the Rabbit and puts it all together, the multilayered top is fitted. It's a work of art and you won't see anything like it this side of \$10,000.

Now you know that two of VW's Wolfsburg Editions are from Osnabrück. What about the Rabbit and Jetta? The Rabbit is from the Pennsylvania plant, and equipped as it is, it's a great \$6,990 package. The real Wolfsburg, my choice for an all-around family car, is the Jetta. It bundles function and fun into a single vehicle. The Jetta we drove around Osnabrück (below) is a knockout. Don't wait for a convertible version, though. The one we photographed was put together by Karmann craftsmen just for fun.



VW's convertible Rabbits are lovingly handled at Karmann works in Osnabrück.

duction of the Wolfsburg Edition Sciroccos and Rabbit convertibles, I watched a one-minute celebration as the 600,000th Scirocco came off the line, a silver California version, the



Wolfsburg Jetta is \$8,390. Topless version, seen at Karmann museum, is experimental.

Racing with Renault

Wherever you live, it's hard to go around the block without seeing at least one Alliance sedan on the road (and this fall there'll be an Encore, a hatchback version). On the track, a Kelsey-Hayes Alliance is being fielded by Detroit Renault dealers and you can catch it at IMSA Champion Spark Plug Challenge races.

The Alliance campaign is only the latest Renault entry in motorsports. LeCars have been buzzing around East Coast circuits in the Renault Cup, and



Renault Alliance, set up for IMSA competition, will have Cat Kizer at the wheel.

in Formula One Grand Prix racing the Renault Team with its yellow turbos is a formidable presence, especially with world champ Alain Prost and American Eddie Cheever doing the driving.

Subaru turbos



Turbo on 4wd wagon boosts hp up to 95.

The turbocharged Subarus are here. The station wagon and BRAT are both Turbo-Traction models, an apt name for these tough four-wheel drives which now have blowers on their 1.8-liter, fuel-injected Fours. Their on-demand 4wd is coupled with an automatic transmission, making them unique in their class. We're itching to get our hands on these three-speed automatics for some serious scrambling, because they look like Subaru's best vehicles ever. And they've got good looks to go with the traction. Now, if they'd just dump the dumb badge with all the stars.

FM



It's worth its weight in tough protection.

If you're driving one of today's precision-engineered, high performance cars, you need tough engine protection. That's why Pennzoil GT Performance is specially formulated in an SAE 20W-50 weight to stand the strain high RPM's put on motor oil. GT Performance is also available in an SAE 20W-40 weight.

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staying power to keep giving your engine the protection it needs—even under intense pressure. And GT Performance has built-in friction reducers to help high revving engines run easier, increasing their efficiency.

Pennzoil GT Performance

provides tough protection, too, for hard-working, load-carrying pick-ups, vans and RV's.

A top quality product of Pennzoil's long on-track experience...this is the oil with the extra weight to give tough engine protection for your high revving, high performance car.

Pennzoil GT Performance Motor Oil

Extra Weight for Tough Protection

T/A[®] HIGH TECH[®] RADIALS



Objective: Build a remarkably tough radial with a rugged appearance that's aggressive enough to meet the challenge of any terrain.

Solution: The Radial Mud-Terrain T/A[®]

The Radial Mud-Terrain T/A[®] tire's aggressive, nondirectional tread design offers excellent traction in deep mud or snow. Scalloped/offset shoulder lugs give maximum bite. And low rubber-to-void ratio in tread area provides excellent self-cleaning action.

The Radial Mud-Terrain T/A—the first and only race-proven radial mud tire—is available in standard sizes to fit most original equipment wheels. And every Radial Mud-Terrain T/A is as aggressive as it looks, with bold raised white letters and a large rugged tread pattern.

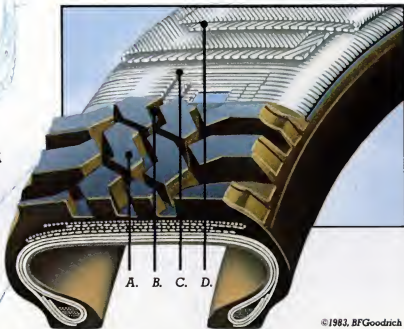


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BFGoodrich makes a complete line of advanced T/A® High Tech® Radials, including the Radial Mud-Terrain T/A and Radial All-Terrain T/A.™ These radials are respected worldwide for their impressive racing record and outstanding road performance. If you're looking for a rugged radial with performance you can depend on, there's a T/A High Tech Radial designed for you.

The design of the Radial Mud-Terrain T/A includes this unique combination of advanced materials and technology:

- A. Tread pitch sequencing for a quiet ride.*
- B. Large center grooves to help reduce hydroplaning.*
- C. Three-ply radial construction helps reduce sidewall bruising.*
- D. Four-ply DuroGard® folded belt system for durability in the critical stress areas.*



ALL OUTDOORS



OMC's hot new 150-hp outboards

"Bass fishing boats are really at the leading edge of boating performance," Ron Shearer was telling me as we stood on the dock. A professional tournament fisherman, Ron was explaining why he and many other bass pros are using Johnson's new 150-hp GT V6. It's a hopped-up version of Johnson's standard 150. Changes include recalibrated carbs, a redesigned gearcase and lower unit for freer exhaust flow, and racing-style motor mounts for high-speed steering responsiveness. In tournament bass fishing, getting to the good spots the quickest can be the dif-

ference between winning and losing.

"Go ahead," Ron said. "Take her out and see what you think." That was what I had been waiting to hear.

I stepped down into a Ragin' Cajun bass boat and started up the big V6. For the next several hours, I gave this baby a workout. Wind and water conditions were not ideal. But even so, I saw 65 mph on the speedo many times. With better weather and Johnson's new SST Raker prop (designed for boats that can do at least 60 mph), 70 mph-plus is not unrealistic.

If you're not into tournament bass fishing, but like hot performance as I do, you'll also enjoy the GT 150.

Evinrude offers its own version of this V6—the XP 150. The only differences between the two engines are cosmetic.

Take it from me. When you get on the gas, these motors will definitely move your eyeballs back in their sockets.



With Johnson's hot new GT 150, we took the 17-foot Ragin' Cajun up to 65 mph. That's one fast bass boat.

Duffel for three-wheelers

For years, I've been using an Eclipse tank bag on my street motorcycles. It's durable, handy and well made. Now, Eclipse has come out with a duffel for all-terrain vehicles (ATVs). It lashes easily to any luggage rack and carries enough gear for several days on the trail.

Rugged Cordura nylon makes the Explorer tough enough for even utility or farm use. The 5,000-pound-test

webbing handles wrap completely around the duffel and snap together inside a comfortable leather grip. Three separate outside pockets help keep gear organized.

The duffel comes in black, gray or brown. It costs \$63 (including shipping and handling).

You can order it directly from Eclipse Inc., Box 7370, Ann Arbor, Mich. 48107.



Eclipse duffel straps to the rack of any ATV. A large top flap opens out of way for access to main baggage compartment.

RV industry on the upsurge

In 1972, Americans bought slightly over half a million RVs. Fuel shortages, higher interest rates and uncertainty about the economy caused sales to drop to an all-time low of 105,000 in 1980.

People in the RV industry are smiling again, however. Projections for 1983 call for slightly more than 200,000 RVs to be sold. "And that," one RV executive told me recently, "is the best news we've had in a long time."

Wing sailboat

Revolutions don't happen everyday, especially in sailing. But Ron Latham may have started one. Ron is a veteran glider pilot who turned to sailing as a substitute for the high cost of soaring.

His new boat is called, appropriately enough, the Wingsailer. It is the first true wingsail that I've seen offered commercially. A 27-sq.-ft. wing provides about the same driving power as a conventional sail with twice the area. The wing itself is a Dacron sail stretched taut over a three-sided fiber-



Wingsailer's 27-sq.-ft. wing weighs only 10 pounds. Craft has positive flotation, can be righted quickly in a tip-over.

glass frame. Wingsailer is easier to sail than a conventional sailboat, and its tendency to heel is much less. The 12-ft. fiberglass Wingsailer costs \$1,495, weighs 55 pounds and is cartoppable.

To locate the nearest dealer, write Fiberglass Unlimited, 8809 Running Oak Drive, Route 8, Raleigh, N.C. 27612.

Traveling on a budget

The 1983-1984 National Directory Of Budget Motels lists over 2,200 low-cost chain motels in the United States and Canada.

Overnight stays generally run from \$15-\$25 for a single room, plus \$3-\$5 extra for a double. The book costs \$4.95, including postage and handling, from Pilot Books, 103 Cooper St., Babylon, N.Y. 11702.

PM

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America's Most Versatile Stoves and Fireplace Inserts

The Federal Convection stoves and fireplace inserts represent a unique combination of efficient design, attractive styling, and use flexibility. They are America's most versatile stoves and inserts.

A Superior Design

The Federal Convection uses an extraordinary system of double walls surrounding the bottom, back, and top of the firebox to create a flow of very warm air from within the stove. The result? Greater circulation of heat than is possible with an ordinary stove. A 100 cfm fan can be added to circulate the heat further still.

Cast Iron Quality

Every Federal Convection is hand cast from pure virgin iron. They are made only from *cast iron* (not plate steel). Cast iron has been used in stove making for centuries because of its durability and excellent heat transfer properties, and the best stoves are still made entirely from cast iron. Each stove is then put together by hand and carefully inspected before it leaves the foundry.

Burn Wood and Coal

The Federal Convection will burn both wood and coal, and comes with all the parts necessary for burning each. What makes the Federal an especially convenient wood-coal combination is its easy fuel conversion. Many wood-coal stoves require several hours work plus partial disassembly of the stove to switch fuels. You have to choose one fuel in the fall and stick with it throughout the season. With the Federal, you can switch from wood to coal or back in *less than a minute*, allowing you to burn a log or two on a milder day while still burning the more intense coal on colder days.



The Federal Convection can be converted from use with wood to coal in less than a minute.

Easy to Start

The primary air source brings in air from beneath the grate, creating a bellows effect. It makes starting a fire, even with unseasoned wood or hard coal, surprisingly simple. A secondary air source, along with a cast iron baffle, encourages secondary combustion for more efficient use of your fuel.

Easy to Use

Both front and side loading doors make it easy to refuel your Federal Convection. An externally operated shaker grate allows you to shake down a coal fire at any time, and since the doors remain closed, no dust will get into the room. Dial dampers control the air supplies so they can easily be adjusted to provide the right amount of heat.



The Federal Convection cast iron fireplace insert.



An ashbin and tray provide for easy removal of ash.

Easy to Clean

The Federal Convection comes with an ashbin and slide-out tray. It makes removing ash a *clean*, fast, and easy job. You'll never have to shovel ashes out of your stove, nor have to put out the fire first to remove them.

A Stove and A Fireplace

The Federal Convection is both a stove and a fireplace. It's meant to be used primarily as an airtight stove, but its doors can be opened at any time to change it into an open fireplace! A firescreen is provided so that sparks won't fly. The Federal has two high-temperature glass windows so you can watch the fire even when the doors are closed.

Installation Flexibility

The Federal Convection has been designed to fit all of the most common installations: free standing, in front of a fireplace, or (with the addition of a cast iron sealing shroud) as a fireplace insert. It has flue openings on top and back so the installation can be changed at any time.

Exceptional Styling

While the Federal Convection is known for being a very efficient fireplace-stove, it is also an extraordinarily beautiful one. It has been cast in the tradition of Federal period styling, simple yet elegant. Balanced patterns of lines and arches are accented with solid brass trim.

Catalytic Combustion Federal

Now, a Federal Convection equipped with the *Corning catalytic combustor* is available too. Taking advantage of the latest advances in woodburning technology, the Catalytic Federal provides cleaner, more efficient burning of wood while still being easily convertible to use with coal.



Palladium-coated combustor in the Catalytic Federal Convection increases combustion efficiency while providing for cleaner, smoke-free burning of wood.

An Old-Fashioned Value

The Federal Convections are not only exceptional stoves, they are *exceptional values*. They represent high quality workmanship and excellent design at a reasonable price. A Federal Convection or any of the other fine stoves from Consolidated Dutchwest are meant to help you save your hard-earned dollars, not spend them. To learn more about them, send in the attached post card or call our toll-free number (1-800-225-8277).

SAVE 50% TO 90% ON YOUR HEATING BILL.



More and more Americans are turning to wood and coal to reduce their heating bills. In homes from Maine to Montana, thousands of Consolidated Dutchwest stove and fireplace owners are saving 50% to 70% and even 90% on their heating bills. Comfort? The kind you used to take for granted. Start saving *this year*. Send for your **FREE** catalog of our complete line of *cast-iron* stoves and fireplace inserts today!



A superior stove—Our big, all-cast-iron Federal Convection heats 8,000 to 12,000 cu. feet, stoking from front and side to burn a full load of 22" logs or 35 pounds of coal. Conversion from one fuel to the other takes less than a minute for long hours (10 with wood, 20 with coal) of clean, efficient combustion.

Efficiency built right in—A sealed convection system moves air freely around the firebox, and a 100-cfm fan (standard on the insert, optional freestanding) boosts airflow fivefold. Flue outlets top & back let you install the stove in front of the fireplace, inside it, or free standing. Other features: shaker grate, ashbin & ashdrawer, baffle, dial-controlled primary & secondary airflow, solid brass trim, glass viewing windows, and screen for open-hearth burning.

Catalytic Federal—And now, we offer a Federal Convection equipped with the Corning® Catalytic Combustor for cleaner, more efficient burning of wood.

Stoves can be delivered right to your door anywhere in the continental USA.

◀ **The Federal Convection can be installed free standing, or as a fireplace insert.**



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CAR CLINIC



Seeking sense

Maybe you can help me find the reason why my 1977 Dodge Aspen is stalling and idling rough only when the engine is cold. So far, I've rebuilt the carburetor and replaced the sparkplugs and cables, distributor cap, rotor and exhaust gas recirculation valve. There is no vacuum leak. A vacuum gauge test shows a solid 20 in. Hg. Slow and fast idling speeds and ignition timing are adjusted correctly, and the automatic choke works as it should. It just doesn't make sense. Where do I look next?—Stephen Cramer, Chapel Hill, N.C.

Up the air cleaner—at that out-of-sight, out-of-mind heated inlet air system. When a cold engine is started, the

air-control valve in the air cleaner snorkel is supposed to close, diverting heated air from the exhaust manifold into the carburetor. If the valve stays open, stalling and rough idling result.

There are three reasons why an air-control valve can stick open: 1. a defective temperature sensor in the air cleaner; 2. a bad vacuum diaphragm on top of the snorkel; 3. an air-control valve stuck because of corrosion.

Check to see if the air-control valve closes with the cold engine idling. You may need a mirror and light to see inside the snorkel. If the valve isn't closed, see if vacuum is reaching the control diaphragm.

If vacuum isn't reaching the diaphragm, replace the temperature sensor. If vacuum is reaching the diaphragm but it isn't closing the door, replace the diaphragm and check the door mechanism for binding.

Another common cause of cold driveability problems with Chrysler products is a failure of the electrically assisted choke heater on the intake manifold. If current fails to reach this heater while the engine warms, the choke will remain on too long and the engine will stumble and run rough for a while. This condition usually won't make the engine run rough until it has been operating a couple of minutes. The roughness will clear up once it is fully warmed.

Rocking and knocking

My 1982 Ford F100 pickup truck has a 3.8-liter engine that knocks when the engine, warmed up, runs at idle. The knock disappears as I accelerate and at speeds above idle. My dealer says they all do it, and it's nothing to worry about. Is he speaking with a straight tongue?—Harry Matthews, Stillwater, Okla.

His tongue may be straight, but his facts aren't. Knocking 1982 3.8-liter engines in Fords and Mercurys should be repaired. Usually, the reason is a camshaft that's shifting back and forth.

The repair involves replacing the camshaft thrust spring and needle bearing thrust button at the end of the camshaft with new parts. The new camshaft thrust spring is part No. E3DZ-6297-B, and the new needle bearing thrust button is E3DZ-6298-A.

Long shot

Transmission fluid on the underside of my car and some on the garage floor led me to check the transmission fluid level. It showed a significant loss. The car is a 1982 Oldsmobile Ciera, which is equipped with a 2.5-liter engine and automatic transmission. I've exceeded the warranty and before I have repairs made, I'd like to have some idea of what's involved. Can you tell me?—Ralph Riley, Tacoma, Wash.

If you're lucky and it's what I hope it is, it's a minor repair. Some 1982 and 1983 125C automatic transaxles got into the field with long bolts that attach the auxiliary valve-body cover to the auxiliary control-valve assembly. These longies bottom out, causing a gap between the cover and valve assembly through which fluid leaks, then runs out the transmission vent.

The repair is simple. Remove the valve-body cover and gasket and replace the four long bolts with four shorter (M6 × 1.0 × 20 mm) bolts (part No. 8643250). Torque the bolts to 8 ft.-lb. and install the valve-body cover, using a new gasket.

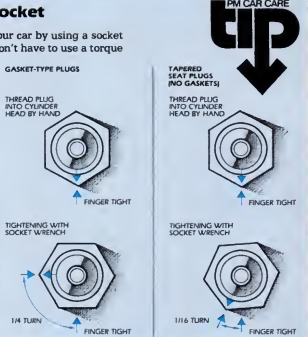
If this is not the cause of your trouble, then the leak could be coming from

(Please turn to page 22)

Lock it with a socket

Installing sparkplugs in your car by using a socket wrench is effective. You don't have to use a torque wrench. However, you do have to be careful. If you leave the plugs loose, compression is lost. And if you overtighten the plugs, you can get them seized so tightly that the sparkplug ports will be stripped when you try to remove them.

These illustrations show how tight is tight. You should tighten the sparkplugs 1/4 turn beyond finger tight if the plugs use gaskets, or 1/16 turn beyond finger tight if they don't use gaskets. This method will work well. Trust me.





TOUGH FORD V-6 RANGER!

New V-6 Ranger—most powerful V-6 in any small pickup! Now tough Ford Ranger has V-6 power and performance—with more horsepower and torque than Chevy S-10 or any import!

Built Ford tough—tested features like forged Twin-I-Beam front suspension and double-wall box construction.

Wider cab than any import—widest of any small pickup! Available in 4x2 and 4x4 models.



OFF-ROAD MAGAZINE'S "4x4 OF THE YEAR"

AMERICA'S TRUCK

**TOUGH
FORD
RANGER**

CAR CLINIC

(Continued from page 20)

a number of places, including the trans-axle pan, vent pipe, converter or case. A transmission mechanic should be able to fix it.

Hearing wheeling

My 1982 Lincoln Continental developed a front wheel noise that my dealer tried to eliminate by servicing the wheel bearings. This hasn't helped. What other front wheel component can cause a wheel bearing-type noise?—Fred Harris, Washington, D.C.

Would you believe tires? It could be caused by abnormal wear on the outer edges? To find out, put the rear tires on the front and the front tires on the rear. If the noise disappears or diminishes, you've got your answer.

Harsh backdrop

Why does my 1981 Buick Century, which has a 3.8-liter engine, shift into reverse with such a terrific jerk? The problem doesn't exist when shifting into a forward gear. The dealer has replaced the modulator and tells me everything is working properly, including the on-board computer. He says

other models like mine don't have the problem, and there's nothing he can do about it. I can't believe that. Please help.—Ross Smith, Houston

Don't believe it. Any 1981-82 GM car with a 3.8-liter engine and 350C automatic transmission that has this trouble can be fixed. The cause of the

trouble is inside the transmission, which has to be taken apart. Essentially, the following has to be done:

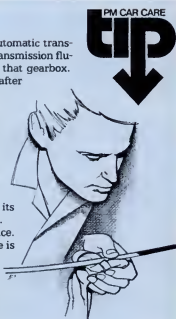
- Every other spring in the low-and-reverse spring pack (there are 17) has to be removed, up to a total of eight.
- A new reverse-clutch piston (part No. 344212), direct-clutch piston (No.

Eyeing transmission fluid

The simple ways are still the best ways. Take automatic transmissions. Just looking at and sniffing automatic transmission fluid will tell you lots about what's going on inside that gearbox.

With the transmission nice and hot (that is, after driving the car for at least 10 miles), clean the area around the fluid dipstick. Pull the dipstick out and inspect and smell the fluid (don't burn your nose). You'll find one of these conditions:

- Fluid has a normal (reddish) color and doesn't smell burned. Okay so far. Now, wipe the fluid onto a white cloth and look for specks of metal. As long as you find none, you can go on your way.
- Fluid looks dark, like it's burned—and smells like it. This is a sign that a clutch-disk pack is on its way out. The transmission will soon need repair.
- Fluid looks like varnish or has a milky appearance. The problem here almost always is that antifreeze is leaking into the transmission because of a hole in the transmission oil cooler. Drop the transmission pan, drain the fluid and replace the filter. Next, find and fix the leak. Install fresh fluid, then check the fluid after driving the vehicle 1,500 miles. If it still looks kind of icky, service the transmission again.



THE "EYES" (AND NOSE) HAVE IT

ITCHING FOR A CURE FOR ATHLETE'S FOOT? DR. SCHOLL'S HAS IT!

If you've got athlete's foot, you need more than relief. You need a cure. Dr. Scholl's cures athlete's foot because it contains Tolnaftate, the clinically proven ingredient doctors recommend.

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NOW EVERY COLGATE INSTANT SHAVE HAS A NEW RICH THICK LATHER.

6260197), forward-clutch piston cushion wave plate (No. 8640176) and clutch plate (No. 6261071) have to be installed.

■ A new pressure plate (part No. 6261349) may also have to be used.

Help your dealer by suggesting that he read service bulletin 82-T-110.

Feeling wheeling

I'm in a quandary as to why my 1977 Plymouth Volare shimmies when it's up past 55 mph. Mechanics have aligned the front end, done complete brake jobs and replaced tires. It's been an expensive and frustrating experience that seems to have no solution. Do you have any ideas?—C.D. Leonard, DeFuniak Springs, Fla.

Several. A high-speed shimmy can also be caused by:

- A slightly bent wheel and/or an out-of-round tire.
- Enlarged wheel lug holes.
- A wheel/tire assembly that's not in balance.
- A worn idler arm.
- A steering gear that has to be readjusted to specification.

Find a mechanic who is NIASE-certified in steering and front-end service and have him do a complete inspection and alignment.

Hit the mark

The power steering in my 1981 Toyota Celica moans when the engine is first started. Steering is normal, and the power steering fluid is within the limits shown on the dipstick. Does this noise spell future trouble?—Ken Roberts, Columbia, S.C.

Probably not. The noise may be the result of air in the power system, which has entered because the fluid level is low. Yes, I know you said the dipstick shows that the reservoir is full. But your dipstick may be the old one which isn't calibrated to show cold and hot levels. If you go by the old dipstick, there's a good chance of underfilling the system.

You can get the new dipstick from a Toyota dealer. If you want to continue using the old dipstick, check fluid when the engine is warm to see that the level is at the top mark or above it by up to 5 mm (0.2 in.). Don't get shook up if you follow what I tell you and still get some noise. Toyota says it's normal. **PM**

DO YOU HAVE A CAR PROBLEM?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be discussed in the column.

SERVICE TIPS

■ Oldsmobile says some 1982-83 Toronados have bad breath—literally. If a garlic-type odor is inside your car, Olds dealers will replace the steering column-to-dash panel cover (No. 1261621).

■ Lack of power, poor fuel economy and poor cold-engine driveability in 1983 Ford Rangers (two-liter engine) may be caused by a malfunctioning distributor mechanical advance. Ask your dealer to test centrifugal advance response according to technical service bulletin (TSB) 83-1 and, if necessary, replace the distributor (part No. E3TZ-12127-B).

■ Rough idle, engine surge and loss of fuel economy with a 1983 Chrysler Corp. 2.2-liter engine may be the result of a split in the flow control valve-to-intake manifold hose. If so, a new flow control valve assembly (part No. 4213590), which includes rubber hoses, has to be installed, according to TSB 14-16-83.

■ When a pre-1982 Honda carburetor is overhauled, install an auxiliary fuel filter at the carburetor to trap dirt that gets past the primary fuel filter. Dirt can cause flooding or disrupt the idle circuit. For 1975-81 Civic CVCC and 1976-78 Accords, order the extra filter using Honda control No. 1121318; for 1979-81 Accords and Preludes, use Honda control No. 1121326. The Civic 1200 already has a fuel filter at the carburetor.

APPLIANCE CLINIC



Bypassing a dryer buzzer

We have a General Electric gas dryer Model DDG7188PHLWH, serial No. TV310331G, equipped with a buzzer to signal the end of the drying cycle. The buzzer drives me crazy and I would like to eliminate it. Can I bypass the buzzer without affecting the timer?—Brian MacLean, Danvers, Mass.

Your model dryer has a mechanical buzzer built into the timer assembly.

On the control panel, there should be a switch next to the timer knob which turns the buzzer on or off. This switch may not be working. There are two ways to stop the buzzer noise. Either replace the timer assembly or bend a little metal arm inside the timer which causes the noise.

To bend the arm, first disconnect the power to the dryer. Remove the back

service cover to the control panel. Now look at the back of the timer. To the right side you'll see the timer motor with a black coil and two wires above it. Directly above the black coil and wires there is a little metal arm which is positioned horizontally across the timer.

Reach into the timer with a pair of needle-nose pliers. Grab the metal arm and bend it upward. This should stop the buzzer. Replace the control panel, plug in the dryer and you're all set.

Cold burner

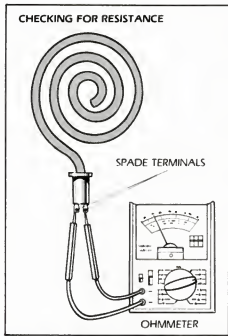
We have a Frigidaire electric range, Model RGC-35, serial No. 62CGD533. The rear left surface doesn't heat at all, but the light on the panel comes on. Any help?—Louis Washowich, McKeesport, Pa.

Sounds as if your problem may be a broken wire, open surface element or a defective switch. First, disconnect the range from the source of electricity by unplugging the range, tripping the circuit breaker or removing the fuses. Next, raise the surface unit, removing the drip bowl and trim ring. Take out the two surface-unit mounting screws which attach the heating element and bracket to the top. Lift the element up and out of the cavity. Check for a broken wire to the element. This can usually be repaired by stripping insulation and splicing the wires together.

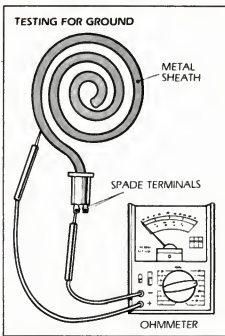
To test the surface unit, gently pull both push-on terminals off the element using needle-nose pliers. Next, use an ohmmeter set at RX1. Place the meter probes across the two terminals of the surface element. You should get a resistance reading near 37 ohms. If you get no reading, replace the element.

Next, test from the metal sheath of the element to either terminal of the element. There should be no meter movement. If the meter needle moves, this indicates a grounded element that must be replaced. If the surface unit tests okay, it's most likely that the infinite heat switch is faulty.

To gain access to this switch, remove the rear access panel. The replacement element is Frigidaire part No. 6590804. The replacement switch is part No. 1133186. They are available in your area from Best Service Co., 1100 West-



To test for resistance, set the ohmmeter at RX1 and place the probes as shown (left). The reading should be near 37 ohms. To test the ground, place the probes as indicated (right), then set the meter at RX1. The needle shouldn't move.



ern Ave., Pittsburgh, Pa., or from Collins Appliance Parts Co., 1533 Metropolitan St., Pittsburgh, Pa.

Refrigerator condensation

I have a Montgomery Ward Signature Frostless refrigerator, Model 1642. In the summer, it usually has several inches of condensation on the outside edge around the door. Also, mildew builds up around the gasket. I checked the door gasket using a dollar bill in the closed door. It didn't slip out easily. What do you suggest?—Diane Nounanen, Austin, Tex.

Most likely, a burned out cabinet

flange heater is the source of your problem. The heater is between the outer cabinet and the inner liner of the refrigerator. When the heater is working properly, the area between the door gasket and edge of the cabinet should feel warm. The heater helps dry moisture. Have a service technician check the refrigerator and install the proper heater kit for your model. **PM**

If you have a problem with any appliance, send your question, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

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5 mg

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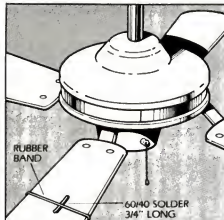
2 mg



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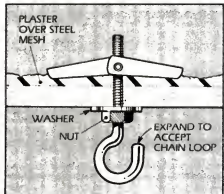
HINTS FROM READERS

Balancing a ceiling fan



A 3/4-in.-long piece of wire solder can help balance a wobbling ceiling fan. Attach the solder with a rubber band midway along one of the blades. The additional weight will make the fan run smoother if you have found the light blade. If the fan runs rougher, repeat the procedure until you find the light blade. Further balance the fan by moving the solder in or out on the blade. Use electrician's tape to secure the solder. Weight a second blade, or use a longer piece of solder, if the blades are still unbalanced.—*Harry Loudon*

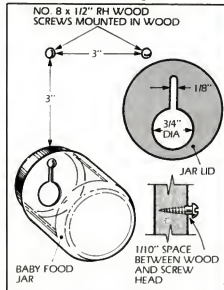
Hanging a swag chain



You can hang a chain from a mesh reinforced plaster ceiling, even where you don't have a joist. Simply use a toggle bolt with spring-loaded legs. However, substitute an eyebolt for the standard bolt. Add a washer and nut to the eyebolt before you insert the toggle, so the points on the legs will seat permanently. Spread the eyebolt in advance to slip on the chain.—*Craig Wilson*

HINTS FROM READERS

Small parts storage



To store small items without shelves, I mount baby food jars on the side of a wooden cabinet or on a wall. First, I install roundhead screws, spaced 3 in. apart on a grid. I use wood screws in a cabinet, or screws and plastic anchors in a plaster wall. I cut a keyhole shape in the jar lid, using a flexible shaft tool or a small round file. Don't fill the jars full.—*Dan Cote*

Lathe carriage travel scale



Often in lathe operations, you must gauge carriage movement with measuring-scale accuracy. To do so, a ruler is mounted on the lathe bed so the pointer on the carriage can travel along it. The setup shown is effective. Back a transparent plastic ruler with a strip of light-colored paper, then clamp it to the bed with a strong permanent magnet of the type used on door latches. Fasten a pointer of stiff wire to the carriage with the screw holding one of the felt wiper pads.—*Walter E. Burton*



ESCORT WINS AGAIN! MAY 1983 CAR and DRIVER TEST

"The Escort looks so comfortable, contented, and familiar at the top of the heap that it's hard to see that something new and special has been added... live with a new Escort for a while and you'll realize it has advanced new circuitry that should go down as a genuine breakthrough."

ESCORT WINS NOV 1982 CAR and DRIVER TEST

"The Escort, a perennial favorite of these black-box comparisons, is still the best radar detector money can buy. The Escort is a quality piece of hardware."

ESCORT WINS DEC 1981 BMWCCA ROUNDEL TEST

"The Escort is a highly sophisticated and sensitive detector that has been steadily improved over the years... In terms of what all it does, nothing else comes close."

ESCORT WINS SEPT 1980 CAR and DRIVER TEST

"Ranked according to performance, the Escort is first choice... The Escort boasts the most careful and clever planning, the most pleasing packaging, and the most solid construction of the lot."

ESCORT WINS MAY 1980 BMWCCA ROUNDEL TEST

"This unit... consistently outperformed the other products and is the standard to which the others are compared. If you want the best, this is it. There is nothing else like it."

ESCORT WINS FEB 1979 CAR and DRIVER TEST

"Only one model, the Escort, truly stood out from the rest... once you try the Escort, all the rest seem a bit primitive. In no test did any of the other detectors even come close."

Talkback with Jerry Galvin

Tune in America's New Weekly Satellite Call-In Comedy Talk Show. Mr. Galvin is a master... his show is so unusual that people as fondly set aside time to listen... (The Wall Street Journal) Sunday evenings on public radio stations. Check local listings.

ST/O/P
**THE
 FIRST
 RADAR
 DETECTION
 ADVANCE
 SINCE
 SUPERHETERODYNE**

ESCORT: "A GENUINE BREAKTHROUGH"

—CAR AND DRIVER

If you keep up with magazine tests, you know that ESCORT does more than just outperform other radar detectors. In its most recent evaluation, Car and Driver concluded: "The Escort radar detector is clearly the leader in the field in value, customer service, and performance..." But performance, as measured by warning distance, is not the new breakthrough. After all, ESCORT has been beating all comers since its introduction in 1978.

Now There's More To It

While long detection range is obviously essential it does nothing to solve a problem that has cropped up in the last year. In fact, increasing range by itself just makes the problem worse. If you already have a good superheterodyne unit, you know what we mean. A new generation of imported detector transmits radar signals, and can set off your unit as far as a mile away. The longer the range of your unit, the farther away you find them. As Car and Driver pointed out last November: "Since there are far more detectors on the road than police radar units, interference... could become a genuine nuisance."

Low Level Contamination

At first it was just an irritation. At least ESCORT owners had a way of distinguishing the polluters from the real thing. Our unique audio warning differentiates between the two police radar bands: it "beeps" for X band and "braps" for K band. The polluters' trashy signals triggered both warnings at once, and made a new sound—different than the sounds for police radar. (The rest of the industry didn't even know there was a new problem. Their detectors were making the same sounds as always, just more often.)

Radar Epidemic

As more and more of the "polluting detectors" hit the streets, the problem became more serious. If one of the "polluters" is approaching in an oncoming lane, the alarm from your detector is brief. But if it's traveling the same direction as you, your alarm can go on for miles. And the offending detector doesn't have to be in the car right next to yours. It can be ahead or behind, and up to a mile away. A very serious problem indeed.

Pollution Clean-Up

The problem required an entirely new approach. Examining the interference from these imports, our engineers discovered a subtle difference between their signals and those of police radar, even though they were on the same frequency. The solution, then, was to design new circuitry that would reject the pollution while—and this was the hard part—maintaining ESCORT's industry-leading response to pulsed and instant-on radar. We named it ST/O/P™ (Statistical Operations Processor), and it consists of a CMOS digital processor with built-in memory. ST/O/P is not simple, and it's not cheap. But it is, in our opinion, the most important breakthrough in radar detection since superheterodyne. Car and Driver would seem to agree: "Now, all the world's Radio Shack detectors can hum right by your car in full microwave broadcast mode and your Escort will sit on your dash as politely and silently as a canary-fed cat."



**THE RADAR
 DEFENSE
 KIT**

Peace of Mind

With ST/O/P, we've put the complications necessary to cope with today's radar problems inside—where they work automatically. Just install ESCORT, plug it into your cigar lighter, and turn it on. ESCORT does the rest. If you encounter a signal from a "polluting detector," ESCORT keeps quiet while maintaining its lookout for police radar. If the signal is the real thing, ESCORT immediately alerts you both audibly and visually. And, unlike other detectors that keep you guessing about the radar's location, ESCORT's signal-strength meter moves upscale as you approach and its variable-rate beeper/brapper pulses faster. You get the full story.

It's Simple

If you want the best, there's no reason to look anywhere else. But don't take our word for it. Try ESCORT at no risk. Open the box, install ESCORT on your dash or visor, and take 30 days to test it. If you're not absolutely satisfied, we'll refund your purchase and pay for the postage costs to return it. You can't lose. ESCORT is sold factory direct, so knowledgeable support and professional service are only a phone call or parcel delivery away. And we back ESCORT with a full one year limited warranty. Order today and let ESCORT change radar for you forever.

Do It Today

It's easy to order an ESCORT, by mail or by phone.

By Phone: Call us toll free. A member of our sales staff will be glad to answer any questions and take your order. (Please have your Visa or MasterCard at hand when you call).

**CALL TOLL FREE . . . 800-543-1608
 IN OHIO CALL . . . 800-582-2696**

By Mail: We'll need to know your name and street address, daytime phone number, and how many ESCORTs you want. Please enclose a check, money order, or the card number and expiration date from your Visa or MasterCard.



ESCORT (Includes Everything) . . . \$245.00
 Ohio residents add \$13.48 sales tax.

Speedy Delivery

If you order with a bank check, money order, credit card, or wire transfer, your order is processed for shipment immediately. Personal or company checks require an additional 18 days.

ESCORT
 RADAR WARNING RECEIVER

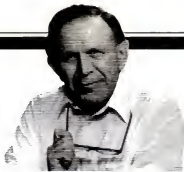
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The new ST/O/P technology incorporated in all new ESCORTs is adaptable to all ESCORTs from serial number 200,000 to 399,999. The "ST/O/P Petrol" costs \$75, and includes adding the ST/O/P digital circuitry with memory and totally retuning and realigning the unit. The ESCORT's one year limited warranty will also be extended to a date one year after the conversion, and of course the shipping costs to return the unit to you are included.

To insure efficient and prompt service, we will use a special reservation system for scheduling the "ST/O/P Petrol" service. DO NOT SEND YOUR ESCORT, but please send a card or letter (no phone calls, please) with your name, address, and serial number to the following special processing address:
 ST/O/P Reservations, P.O. Box 228, Mason, Ohio 45040.
 We will then send you a special shipping label and details on how and when you can send us your ESCORT.

HOMEOWNERS' CLINIC



Applying coating to shingled roofs

We have two layers of asphalt shingles on our roof. We think they'll have to be replaced soon. Is there a coating that can be applied to the shingles to extend their life? If so, how effective is it, where can it be purchased and what is the cost?—M.F. Bonehuski, Kirkwood, Mo.

We received a letter from Carl Way of Canton, Ohio, about the same time

yours arrived. The only difference is that Carl had tried a so-called coating. His roof still leaks, and he can get no aid from the manufacturer, even though he spent \$600 initially. The manufacturer did tell him that he would sell Carl enough material for three more coatings—at a discount.

Carl says his roof lasted seven months. His experience reinforces my

feelings on this subject. When your roof starts to leak and the granules disappear, or the edges start to curl, you need a new roof. And the opinion of a technician in the roofing division of a large independent testing lab further supports my feeling on coatings.

However, there are coatings for built-up types of roofs. But these coatings are mopped into and over fiberglass sheets. They're expensive and best left to the pros to apply.

Block or frame?

I'm thinking of building a house of concrete block, but I have been told that I wouldn't be happy with it because of sweating and dampness. I'm advised to use wooden stick construction. It seems to me that all the commercial buildings in my area are block construction, so the durability must be there. I would appreciate any ideas you have on the matter.—Richard G. Murphy, Reseda, Calif.

Although I live in a stick-built house (that is, wooden framing, studs, plates) which was available when I moved to my present location, I believe that if I had a choice, I would prefer a well-designed, carefully built masonry house. It would include rigid polystyrene insulation on the inside and other proper design features for this type of construction. I would also prefer a stucco exterior with a water-repellent coating.

If you go this route, hire an architect who has experience in this type of construction. He will make certain that the design is aesthetically pleasing, structurally sound and free of moisture problems.

An excellent, illustrated booklet on cement block work is available from the Portland Cement Assn., Order Processing, Dept. PM, 5420 Old Orchard Rd., Skokie, Ill. 60077. It's called *Recommended Practice For Laying Concrete Block*, and is booklet No. PA043M. The 22-page manual costs \$4.

Sweaty patio

We added a Florida room to our house. It has a metal roof sandwiched around what is supposed to be an insulating core. The almost full-length windows

have self-storing screens and glass. In the old days, this structure would have been referred to as a sun porch. All window mullions and joining strips are aluminum.

We have incessant sweating, to the point that it drips on our furniture. We've tried a fan and a dehumidifier. The overhang or soffit has five vents to the attic. The manufacturer won't help us. Do you have any suggestions?—Eli McKay, Clarksville, Ohio

Without seeing the actual installation, I can only speculate on some general ideas. From the brochure you sent, the roof doesn't appear to have a thermal break between the top and the bottom skin. In other words, even though there is reportedly some insulation value in the core, heat is transferred from the hot top surface (in the sun) to the edges and down to the inside ceiling. Thus, you have a hot surface inside the structure. In the evening, when the cooler moist air hits this surface, you have condensation.

If you have adequate attic ventilation, you may be able to vent your porch structure there. However, I wouldn't do it for the following reasons: You may be venting the hot attic air into your porch or, even worse, you may be filling your attic with hot moist air from the porch.

With proper roof insulation, your room should work. I would add several inches of rigid polystyrene insulation, adhered to the top of the roof, to cut down on the amount of heat put into it. I think you should hire a licensed mechanical engineer to investigate the problem, keeping the above theory in mind. His fee will be justified by the peace of mind you will gain by avoiding a second mistake on your addition.

SERVICE TIP

If you have a repaired ceiling with patches showing through in spots, you should know about Textone Ready-Mixed Textures, a texturing paint made by United States Gypsum Co.

By varying the application tool, pressure applied and liquid viscosity, you can obtain a variety of finishes on walls and ceilings. The surface of the texturing paint won't crack or chip, according to the company. Home cen-



Mask wall repairs while painting the wall with Textone Ready-Mixed Textures.

ters and hardware stores stock the paint in four textures—light sand, smooth design, interior/exterior stucco and coarse ceiling. The paint is available in white, but it can be tinted so you can match a particular color in your home.

PM

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send your orders to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

AN AFFORDABLE DREAM

Your own self-employment venture that can earn you \$700 a week!

One thing is for sure. If you work for someone else you'll never get rich. The boss might, but you won't. It's his business, he gets all the money, satisfaction, and recognition. What if you were free to call the shots?

Chimney Sweeping

Here's a new business where you can earn more in one hour than most jobs pay for a whole day. More in one week than a lot of people make in an entire month. You're the boss. You set the hours and best of all, it's fun. You'll work your tail off, but the business will be your baby. I've had people tell me that the August West Chimney Cleaning System literally changed their lives. Not just because of the money they are making or the fact that they use more ivory soap, but mainly because they are motivated. They're doing their own thing and loving it.

How much money?

Recently I telephoned some of the people we helped get started in the chimney cleaning business. I wanted to find out — first hand — just how well they were doing. With their permission, I recorded our conversations. We then had a record made which you can play on your record player when you receive our information. Here's what a couple of them said...

Dave Richison, Ohio

"The 3rd quarter of this year I did \$23,000, the 4th quarter I did \$24,000. We should hit some where between 55 and 60 thousand this year."

Fran Watts, Virginia

"We've used \$200 at the end of the week, it's simply a matter of making a couple of phone calls. The repeats are just fantastic!"

John Moszulski, Canada

"Last month I worked 18 days, and I made 2,600 bucks."

Ed & Mo Simonson, Texas

"We're very pleased with it. We're making a dream come true. We've always wanted some land and thanks to chimney sweeping we now own 30 acres."

"In October of '78 we made \$1,530. That was our first October. OK, now in October of '79, which was last year, we made \$3,245. Now in October of '80 we grossed \$6,593. In one month. We're making two grand a week."

Just what do these people do to earn that kind of money? Sweep chimneys. Six to eight a day if they're fulltime. Two or three an evening plus ten to sixteen on the weekends in the case of part-timers who keep their present jobs. Since the average charge is \$45 for the first and \$35 for each additional in the same house, it's easy

to see how Ed and his wife Mo are making two grand a week.

But Why?

Why would anyone pay \$45 to have his or her chimney cleaned? That can be answered in one word — SAFETY!

When solid fuels such as coal and wood are burned in a fireplace or woodstove, they give off a flammable by-product called soot. What is soot? Soot is a combination of fly ash and creosote. Creosote is the flammable unburned residue left over when wood doesn't burn completely. The creosote combines with the fly ash and the smoke carries it into the chimney flue. This soot then sticks to the flue. When a quarter inch or more of this stuff builds up on the chimney walls, it can cause a dangerous chimney fire.

A Chimney Fire

Imagine this tall stack coated inside with a quarter or half inch of flammable soot. When the right amount of heat and oxygen get this stuff burning, you have yourself a real fireworks show. As the creosote burns, the heat causes the natural draft of the chimney to increase ten fold. What you now have is a blast furnace that looks and sounds like a rocket taking off. The temperature of the chimney fire, 2000-3000 degrees, is enough to disintegrate the mortar holding the chimney together. The flaming balls of soot shooting out the chimney's top can land on the roof and the dry leaves surrounding the house. Needless to say — this situation is undesirable and the people who've lived through it get their chimneys cleaned regularly.

According to the National Fire Commission there were 60,000 chimney fires in the U.S. in 1980 causing \$300,000,000 of damage. 75% of all fatal residential fires in Vermont, for instance were caused by faulty installation and maintenance of woodstoves. Tens of millions of people are using wood to supplement the high cost of oil. There are over 40 million woodburning chimneys in the U.S. These people need you to clean their chimneys.

The Height of Technology

How do you clean a chimney? You do it as quickly and efficiently as possible. The more chimneys you can clean in a day the more lives and loss of property you'll save. And how do you do a good job in record time? You use the most advanced system available — The August West System.

One of the key elements in the August West System is the SootSweeper. This machine is a high-powered, high-volume dust collection unit that was designed specifically for cleaning chimneys. When I first started cleaning chimneys I used a large vacuum truck. It worked well, but they cost over \$20,000 now. I also had a prob-

lem with the 100 feet of hose. It didn't always reach the fireplace from outside. The powerful but portable SootSweeper has the same kind of air-moving muscle as a vacuum truck, but you can bring it right in the house. New filter technology is the key to its efficiency and dependability.

Other key elements of our system are an assortment of high carbon steel brushes, specially designed fiberglass cleaning rods, roof safety equipment, an easy-to-follow handbook with everything from advertising to chimney design, a bi-monthly newsletter, telephone consultation and much, much more. I don't have room to go into all the details right now. Our information kit will explain everything to you.

I'd just like to say that many years and a tremendous amount of devotion have gone into the development of the August West System. We are a strong company with over 5,000 sweeps in our network! You can join us and count on us to help you build a business you can be proud of. We are proud of what we do and the quality of our equipment and service to you reflect our pride.

To sum up, then...

Sweeping chimneys may not exactly be a "Lazy man's way to riches"... you'll work hard... but the pay is exceptional, the demand is steadily growing and new equipment and methods make the job far easier, faster and safer than ever before. Perhaps best of all, this is one of those "dream" businesses that so many of us are always looking for: a business with flexible hours, low overhead and reasonable start up cost, figure about \$2500 to do it right.

Find out more about what it's like to be a chimney sweep cleaning 25 chimneys or more a week. Just call TOLL FREE 800-243-5166 and ask for extension 217. I'll rush you a detailed information kit with the complete August West Story and your 33 1/3 RPM record entitled, "Now, Here It From The Sweeps." We urge you to call us at no obligation, TODAY.

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Fairfield, Connecticut 06430



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Ask for Extension 217 for full details

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DETROIT LISTENING POST



Sneak previews of two key '84 models

We'll have more detailed reports in the next two issues, but here are early impressions of two important '84 models that we've seen and driven.

Oldsmobile 98—The new big Olds, one of the front-wheel-drive GM C-car triplets to be introduced this fall, ably replaces the two-foot-longer, 600-pound-heavier, old rear-drive big Olds. You'll barely notice its more efficient size and weight from inside. It offers virtually the same six-passenger room, and rides and handles almost identically to its larger predecessor, though it is more agile in the corners when pressed.

Exterior styling is traditional GM luxury sedan, chrome and all, while the interiors are more restrained than in the past, but no less plush. Suspension is fully independent, very well isolated from the new unibody, and features standard electronic level control and all-season radial tires.

The standard engine is a 3.0-liter V6. Optional are a 4.3-liter diesel V6 and a 3.8-liter, port-fuel-injected gas V6, both surprisingly good performers. The '84 Buick Electra and Cadillac deVille fwd C-cars differ from the Olds primar-



New fwd Olds 98 is 2 feet shorter, 600 pounds lighter than the rear-drive model.

ily in front, rear and interior design. Cadillac uses its own 4.1-liter aluminum V8 and has doors that wrap up into the roof.

Cherokee/Wagoneer—AMC/Jeep's new downsized Cherokee and Wagoneer 4wds are tremendous improvements over the clunky old Jeep wagons and fully competitive with Chevy's baby Blazer, GMC's GMC Jimmy and Ford's Bronco II. AMC's vehicles look clean, contemporary and somewhat European, while retaining their heavy-

duty Jeep visual and mechanical heritage.

The new 2.5-liter Four, with five-speed manual or optional automatic transmission, performs so well that there's little reason to buy the available GM-built, 2.8-liter V6. Slightly larger than their domestic competition, they offer better interior packaging as well as a choice of part-time or viscous-drive full-time 4wd. The luxury-oriented Wagoneer version is the only four-door in its class.

Chrysler H-car for '85

Some tidbits of information on Chrysler's upcoming H-car, scheduled for a fall 1985 debut, have surfaced from the rumor mill. Intended to take on the likes of Honda's Accord, Mazda's 626 and other foreign and domestic competition in the mid-size family car market, it will be a youthful five-door hatchback priced in the \$8,000-\$9,000 range—just above the company's Reliant and Aries K-cars. However, the new car will share the larger E-class's 103-in.-wheelbase platform. Chrysler's excellent, fuel-injected, 2.2-liter Four will be standard, with the new turbocharged 2.2 optional.

Ford delays fwd conversion

Looking to save tooling money, and obviously having second thoughts about the so-called fwd revolution, Ford is delaying conversions of many of its mid-size and larger models until the

late 1980s and beyond. Most of the cars in question—Thunderbird/Cougar, LTD/Marquis and Continental—have recently been restyled and downsized. An aerodynamic new Lincoln Mark VII coupe is set to debut this fall, and the rest (Crown Victoria/Grand



Ford's aerodynamic new Mark VII coupe has rear-wheel drive. It debuts this fall.

Marquis and Lincoln Town Car) will get their own new looks in the next couple of years. Ford reasons that these products will be competitive enough without the expensive fwd conversion for some years to come. GM and Chrysler, by contrast, are proceeding with plans to go almost 100-percent fwd by mid-decade.

Minivan wars heat up

In a surprisingly bold move, Chrysler plans to offer a second baby van beginning this fall in addition to its much-ballyhooed fwd T-115 (see *The Garageable Van*, page 66, June '83). Also fwd, this little beauty will be imported from Japanese partner Mitsubishi and will be several inches smaller than the homebuilt T-115s in every dimension. Tentative name is Dodge Colt Vista. With a 103-in. wheelbase vs. the T-115's 112 in., it reportedly will hold

(Please turn to page 32)



FORD ESCORT

World leader at the tender age of three.

What do you call a roomy, comfortable, high-mileage car that took on the most technologically advanced cars in the world and outsold them?

You call it a world leader.

And you call it Ford Escort.

A car that has become the best-selling car in the world just three years after its introduction (based on 1982 worldwide production figures).

A car engineered with front-wheel drive for excellent traction

regardless of how wet or sloppy the roads may be.

A car with four-wheel independent suspension, to give Escort the smooth ride of bigger cars.

A car with an interior designed to provide lots of room for four.

A car so affordable that even its price tag brings comfort.

And a car so technically advanced that its compound hemispherical head (CVH) engine delivers refreshing performance plus outstanding efficiency.

33 47 EST HWY
EPA EST MPG

These ratings are for comparison and are applicable only to sedans without power steering or A/C. Requires new FS engine. And your mileage may vary

depending on speed, distance and weather. Actual highway mileage lower. Not available in California.

So if you're looking for a well-engineered car with many winning ways, introduce yourself to the car that took on the world. And won. Hands down.

Get it together. Buckle up.

Have you driven a Ford . . . lately?



DETROIT LISTENING POST

(Continued from page 30)

seven passengers, but with little additional room for cargo. Interestingly, Mitsubishi may import its own version, known as Chariot, by late summer, thus beating its American partner and everyone else into the U.S. minivan market.

Meanwhile, both GM and Ford are rushing to join the fray with downsized conventional rear-drive vans. At 173 in. overall on a 111-in. wheelbase, GM's '85 M-van will be slightly shorter than the 112-in.-wheelbase Chrysler T-115s, but some 8 inches wider and 6

inches higher. Passenger versions will carry eight people compared to the Chrysler mini's seven. Little is known about the competitive Ford product except that it should see a mid-'85 introduction, will be highly aerodynamic for a van in keeping with the new Ford image, and is tentatively named Aerostar. All these domestic minis are intended to supplement, not replace, their makers' full-size vans.

CVTs on the way

One important trend on the engineering side is the continuously variable

transmission, or CVT. Expected to be highly fuel efficient in future small cars, these are essentially infinite-ratio automatics using belts instead of gears. Improved performance and fuel savings result from keeping engine speed in the most efficient range regardless of the vehicle's speed.

England's Leyland Vehicles' Advanced Technology Group recently unveiled a computer-controlled CVT for use in trucks, trains and buses beginning sometime in 1986. General Motors plans production in France of passenger-car CVTs commencing in mid-'85 for certain '86-model European and U.S.-built models. And Ford is stepping up its own CVT research and development after maintaining for some time that a computer-controlled six-speed automatic was a better idea.

Called by some an engineer's dream and the wave of the future, CVTs are predicted to provide a 15 percent fuel economy gain over conventional transmissions in addition to optimum performance in small fwd cars with 2.0-liter and smaller engines. One reason is that the continuously-variable belt system has no slippage.

Calling Buick control

As befits GM's lead electronics division, Buick recently completed a technical-assistance pilot program for dealer service departments and is rapidly expanding it to include the entire dealer body. The program centers on hotlines available to dealer technicians faced with a service problem.

The hotline connects a dealer's service manager to one of a number of engineers standing by with volumes of reference materials and service bulletins, and a video display terminal that can tap into a computer full of data.

In the pilot program, more than half the questions were answered on the first call. Around 85 percent of the questions were answered by the second. Buick's general manager, Lloyd Reuss, believes that today's satisfied customer is tomorrow's repeat buyer. Who can argue with that? You can call up all Buick models on the CRT and ask the computer about options, engine choices, trim packages and so on.

California dreamin'

Last month, we noted that GM planned to set up a styling and design center in California. Now, Chrysler is following suit. A 12-person design staff, dubbed Chrysler Pacifica, will be headquartered at Carlsbad, Calif., about 40 miles up the coast from San Diego. The GM Advanced Concepts Center is located in Thousand Oaks, about an hour north-east of Los Angeles. **PM**

AT A GLANCE, BEAUTIFUL. AT CLOSER LOOK, MUCH MORE.

You'll see impeccable workmanship in every detail. Precision made parts. Hand honed, perfectly mated cutting edges. Fine lustrous finish. Quality you can depend on for like-new service year after year. Quality at no premium in price. Tools by CHANNELLOCK. Send for free catalog. Channellock, Inc., Meadville, Pa. 16335

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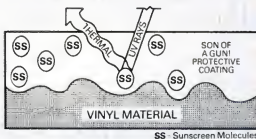
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exclusive sunscreen formula
gives you more than a beautiful shine.**

The sun's ultraviolet rays—they can fade and crack your car's vinyl, leather and rubber.

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STP's exclusive sunscreen formula is activated by the sun itself, to give you long-lasting protection against harmful ultraviolet rays. Used regularly, STP's sunscreen molecules absorb potentially damaging UV rays—changing them to thermal energy

and dispersing them before they can penetrate the surface.



Today, a beautiful shine isn't good enough. You need the beautiful protection of new, improved STP Son Of A Gun! Protector.



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The potential is boundless.

Potential. In many people it goes unrecognized, undeveloped and unused. That's tragic. Because when a person's potential is never developed a terrible thing happens: nothing.

In the Air Force, we look for potential. And we challenge our people to explore and discover that potential for themselves. First with skill training, then with valuable experience.

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Developing potential is part of what aiming high is all about. If we all live up to our potential as individuals, there will be no limits to the potential of our nation.

The Air Force encourages young people to continue their education. Then, with diploma or degree, to accept the challenges of modern technology. For information about these challenges in the Air Force, call 1-800-423-USAF (in California 1-800-232-USAF) or contact a local Air Force recruiter.

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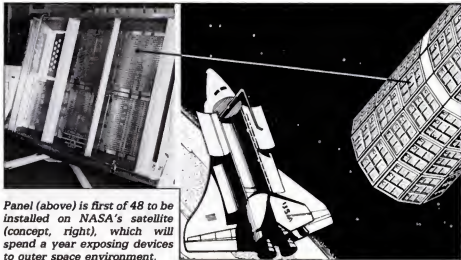
SCIENCE WORLDWIDE



Long-term space stay

NASA engineers have finished the first of 48 panels that are scheduled for launch with the Long Duration Exposure Facility (LDEF) in 1986. The panels will be carried aloft on the 30-foot-high LDEF satellite. Each panel will

contain experiments to determine what happens to various devices—lasers, crystal radios and other things—when they're exposed to the cosmic environment for one year. NASA will use LDEF data to outfit a permanent space lab.



Panel (above) is first of 48 to be installed on NASA's satellite (concept, right), which will spend a year exposing devices to outer space environment.

Alcoholism bubble-burster

If you believe that the children of alcoholics run a high risk of becoming alcoholics themselves, you're not alone, but you may be wrong. A 20-year University of Michigan study of the 10,000 residents of Tecumseh, Mich., indicates that the children of alcoholics tend to become moderate drinkers or abstainers. Hard numbers haven't been released yet, but the researchers say early data show that the children of abstainers tend to become alcoholics at a greater rate than any other single group. The news promises to stir debate in the medical community for a long time to come.

Coming: Atoms in 3-D

Using a combination of computers and electron microscope, IBM researchers in Switzerland have developed a new microscope system that can take three-dimensional photos of objects nearly the size of an atom. The Scanning Tunneling Microscope can resolve surface features of a substance with differences of a few angstroms, or millionths

of an inch. The microscope makes use of a physical phenomenon called vacuum tunneling in which electrons tend to dive between two semiconductors separated by just thousandths of an inch in a vacuum.

Using sensors running from the scope to the computers, the IBM scientists found they could generate an image of the surface where the tunneling electrons have passed. The new technique will allow scientists to look at microchips in greater detail. And it might help them develop chips with far more memory than the most powerful computer chips on the market today.

Seal-proof sounds

Oregon State University researcher Bruce Mate is testing a sound pulsar unit that scares off seals. The animals eat salmon, and that's a problem for the state's fishing industry. Mate's device puts out high-pitched sounds that drive seals away but can't be heard by fish. If it proves itself, the device will end a long-standing debate between fishermen and ecologists.

Love potion No. 9

People in love who undergo neurological examination tend to have a high level of phenylethylamine in their brains, according to McGill University chemist J.A. Schwartz.

It's not clear exactly what the chemical does, but it's also been found that depressed people recently separated from loved ones show correspondingly low levels of the substance.

Interestingly, the love chemical also is found in high concentrations in chocolate. If you ply your love with sweets any time soon, let me know how you make out.

Passion potion No. 1

While seeking to find out why tropical animals avoid eating flowers from the passionfruit tree, a team of researchers from the University of Illinois may have stumbled onto a new drug to battle cancer.

They found the flowers contain chemicals that change cell growth rates in all living things. In tests on laboratory animals, the drug even shrinks tumors. If further lab tests confirm the preliminary results, human trials could be the next step.

The New York falcons

That's not the name of the newest team in pro football. It's a report on something wonderful happening in ecology.

Two pairs of rare peregrine falcons raised in captivity by Cornell University have built nests on two New York City bridges. The vanishing peregrine, on the endangered species list because of overexposure to now-banned chemical pesticides, had not been seen in New York for two decades. Each pair laid three eggs. But the real news is that their nesting instincts survived their period of captivity.

And on the West Coast, two pairs of peregrines released in Los Angeles have built nests atop skyscrapers. They're too young to lay eggs. But scientists feel that the nesting birds demonstrate that endangered species can be restored successfully to the environment even under the most adverse conditions.

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ACTION

Cobra PL-1703 \$15.00

Drive the exciting COBRA. Slum over land or water at breathtaking speeds in your own homebuilt air cushion vehicle. The 14-foot-long craft carries two people, hits 40mph. Two small engines give lift and thrust and a SNUG-FREE air prop lets you go anywhere. Complete plans.



PL-1306 \$49.98

The Scamp

is a winner!

An 80 MPH flying Volkswagen! This VW powered biplane is sensationally inexpensive and flies like a dream. 150 mile range. Proven design. Kits and parts readily available and The Scamp is a handsome piece of work.



B-1307 \$14.95

Boonie Bug

Starting with a junked VW bus chassis, you add some work and love and presto! A smooth riding enclosed van with ATV capabilities plus sleeping and camping facilities. Show-stopper looks too!



PL-1708 Log Splitter

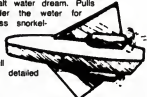
\$8.95

Splitting firewood with sledge and wedges is doing it the hard way. With this hydraulically operated log splitter you can do it by merely moving a lever. Its hydraulic cylinder exerts some 10,000 lbs. pressure. Its backbone is an I-beam and it's powered by a 3-hp gas engine. You can make money with it, too.



PL-1405 Scuba-Tow \$7.95

A motorcycle battery powers this streamlined fresh or salt water dream. Pulls you on or under the water for hours of effortless snorkeling or scuba diving. Rugged and dependable. Big, full scale plans and detailed instruction manual.



PL-1715 Pool Table \$5.95

Pocket billiards is a fun game the whole family can enjoy, and if a pool table is something you have always wanted but couldn't afford, why not build one—this one. It's a beauty. 40 x 80 in., and made mostly of plywood. You get plans, material list and full instructions.



MODELS

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The famous J.I. Case threshing machine steam tractor. 16 separate plans sheets plus instruction booklet. The finest detail work. Stacks firewood but burns alcohol. 9 separate gears in the transmission alone. What a thrill to see it huffing and puffing under its own power.



PL-1200 \$5.00

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The glorious, record breaking flagship of the U.S. Merchant Marine. Though now retired in Norfolk, Va., no passenger ship has ever approached her top speed. This professional quality model is described in detail on 3 full size blueprints. Over 2 ft. long of wood and metal. A stunning project for the craftsman.



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PL-1710 \$7.95

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In the market for a new house—a dollhouse that is? This stately one is modeled after the architecture of the Victorian era and is a dollhouse which will become an heirloom hand-me-down from your children to their children and to their children. It measures 20 x 34 x 46 in., requires two sheets of plywood to build, the sides are covered with clapboard siding, the roof with "slate" shingles topped off with metal filigree. The front swings open, the roof lifts off for free access to its 10 spacious rooms. Plans include full instructions for building.



PL-1227 Sidewalk Classic \$6.95

Powered by an automobile battery (with built-in charger) and generator, it rolls along at a safe, quiet 5 miles per hour. Buy the parts at your hardware and automotive-parts store. It's great for everyday fun on the sidewalk and sensational for parties.

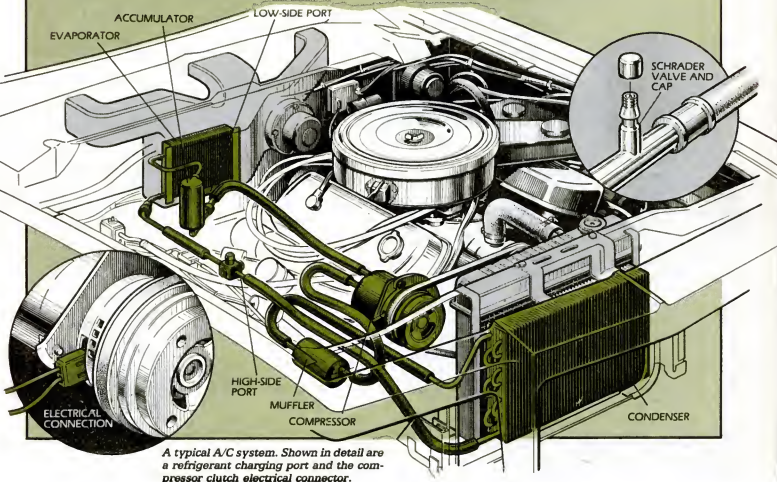
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How To Tune Up Your Air Conditioner

BY PAUL WEISSLER



A typical A/C system. Shown in detail are a refrigerant charging port and the compressor clutch electrical connector.

It's the middle of the summer, that brief time of year when the \$600 you spent for air conditioning is justified. It's also the time when most A/C shops have long waits for appointments.

Air conditioning is not one of those "forget-it-'til-it-fails" systems. You should give it a bit of periodic maintenance. If you make some quick checks whenever you feel A/C performance is below par, you may be able to avoid some problems and correct others.

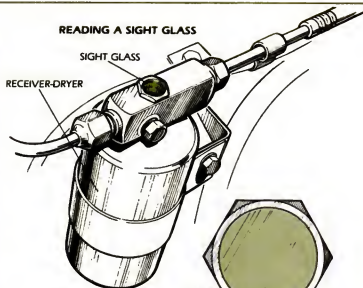
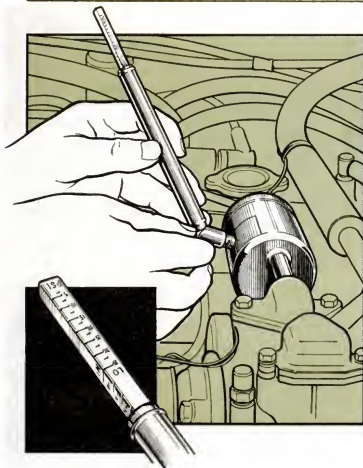
Obviously, you're not anxious to do a lot of work on the A/C (or any other part of the car) during the hottest time of

year. Fortunately, an inspection won't take more than 10 minutes. Much you can do is even less time-consuming.

Begin with a look at the front of the condenser (the finned, tubular part in front of the radiator). It should be clean, so air can flow freely through it and the radiator behind. If it's plugged with road film, leaves, bugs and so on, clean it with a soft brush and a solution of detergent and water. Be gentle so you don't bend the fins and reduce airflow through the unit.

Next, look at the drive belts. Inspect the A/C belt for signs of deterioration.

Check belt tension by pushing down with your thumb midway between the pulleys. It should deflect no more than $\frac{3}{4}$ inch. Do the same for the water pump fan belt. If it's slipping, the engine will run hot and the coolant flowing through the radiator will be much warmer than normal. The radiator and condenser are so close that excess heat from the radiator will be transferred to the condenser and raise the temperature of the refrigerant gas inside. As a result, A/C performance will suffer. In fact, anything that reduces cooling system performance



Left: A quick check of A/C system pressures can be made with this inexpensive pressure gauge. Available in most auto parts stores, the tester resembles a tire gauge. Right and above: A sight glass, found on some systems, checks refrigerant level and aeration.



will affect A/C performance. On front-wheel-drive vehicles, make sure the electric cooling fan switches on when the A/C comes on.

Basic checks

If you feel A/C performance is below normal, make a series of simple checks. First, while a helper turns on the system, watch the compressor. You should see the magnetic clutch on its front hub lock onto the pulley with a slight, but obvious, movement. If it engages, run the engine at fast idle; set the blower fan on high; the A/C lever on max, high, or inside; and the temperature lever on cold. With the car parked far from any wall that might block the flow of air to the condenser, open the hood to minimize engine compartment temperature. Close all doors and windows and allow five minutes for the system to stabilize.

Then insert a thermometer in a center air vent on the dash and take a temperature reading. There are manufacturer's specifications for air temperature, but if you don't have them, this rule of thumb will pinpoint obviously bad performance: The air should be 28°-30° F. below the outside air temperature. (If the weather is humid, the temperature differential is less.)

If the temperature of the air coming out of the register is right, your system

is doing its job. If the system is blowing cool but not-cool-enough air, make a pressure check.

To check system pressures, you need a pressure gauge. Although pros have elaborate equipment, they also use inexpensive testers in the \$8-\$20 range for quick checks. Such testers, sold in auto parts stores, can be used on any system with Schrader (tire type) test fittings. All U.S. cars except a few Ford and AMC products have these fittings. The inexpensive testers resemble tire gauges and are used in the same way.

Locate the two pressure test fittings, which are usually in one of three places:

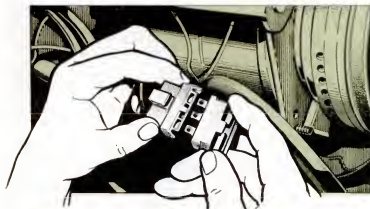
1. On many cars they're on or near the compressor.
2. You might also find them in the tubing that connects the condenser, compressor and evaporator. (The evaporator is a box-shaped part that is found in the dashboard ductwork or protruding from the firewall side of the dashboard ductwork.)
3. They might also be found on the accumulator, a cylindrical part found on some systems.

The A/C has high- and low-pressure fittings. On a few older Ford and Chrysler products, you may find three fittings, two of which are for low pressure. On these Fords, measure pres-

sure at the fittings nearest the compressor. On Chrysler products with three fittings, ignore the one on the cylinder head of the compressor.

Remove the screw caps from the fittings, run the engine at fast idle, and turn on the A/C, setting the controls as you did for a temperature check. After allowing five minutes for the system to stabilize, take your pressure readings.

Compare the readings with factory specs, which can be found in a general service manual. Typically, you should get a reading of about 140 p.s.i. to 250 p.s.i. on one fitting, and 24 to 35 p.s.i. on the other fitting. On some Fords the low-side reading may be as low as 10 to 20 p.s.i. Again, to be sure, you'll have



Many GM cars are equipped with a compressor clutch fuse that will prevent the clutch from engaging if it fails. Connect a jumper across the B- and C-terminal of the holder to test for a bad fuse. If the compressor runs, fuse was defective.



If both low- and high-side pressure readings are 15 percent or more below specification, the system has lost refrigerant. A minor loss of refrigerant is quite likely with cars that are at least three years old. The loss is the result of normal leakage. Adding refrigerant will improve performance.

to compare your results to specs. When ambient temperatures are high, expect the system pressure to be near the high end of the range.

If both readings are 15 percent or more below spec, a minor loss of refrigerant gas is indicated. This is quite likely with cars at least 3 years old. The minor loss is the result of normal leakage over the years. Adding some refrigerant should restore the usual performance.

Before you do this, however, double-check the sight glass. Many older systems and some current ones have a sight glass—a little window in the refrigerant tubing. The sight glass is usually on the receiver, a cylindrical can connected to the condenser by tubing. Don't confuse the receiver with the similarly shaped part called the accumulator, which is used on many current models and is connected by tubing to the compressor. The accumulator doesn't have a sight glass.

With the system running for five minutes, look at the sight glass. If the system has a cycling compressor, a small amount of bubbling in the sight glass is normal during an off-to-on cycle. You can tell if your system has a cycling compressor by watching the front compressor clutch. If it's a cycling system, you'll see the clutch disengage and engage periodically once the system has stabilized. After the clutch engages, however, the bubbling should stop until it cycles off again.

If the system is the type that does not cycle the clutch, you should see no bubbles. If you see continuous bubbling and performance is just so-so, the system is low on refrigerant gas.

If the system doesn't have a sight glass and you don't have gauges, you can check some A/C systems for refrigerant loss with your hands. Just grasp the refrigerant tubing where it disappears into the ductwork, one hand on the thick tubing, the other on the thin tubing.

With the system running, the thick tubing should be somewhat cooler than the thin tube. If the thin tube is colder than the thick one, feel the thin tube about a foot farther away, toward the compressor. If it's warm, the system is probably low on refrigerant.

This test can't be performed on all A/C systems, but it is useful on many of the recently produced cycling-clutch systems.

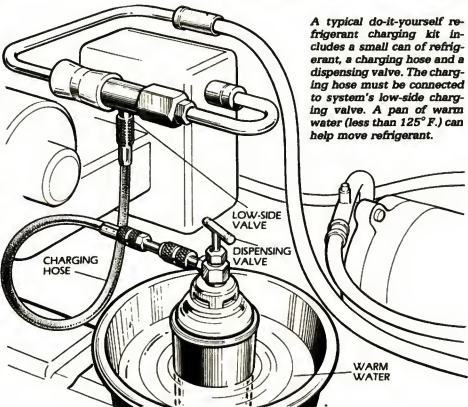
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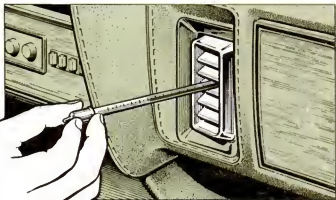
Adding refrigerant

There are many do-it-yourself kits for adding refrigerant, and they come with complete instructions. Just be sure to connect the hose from the refrigerant can to the low-pressure test fitting. On most GM and Ford products, the hose in the kit will thread only onto the low-pressure fitting, so you can't make a mistake.

Hold the can upright while the system is running. Rub the can with your hands or place it in a pan of warm tap water (no hotter than 125° F.) to speed flow into the system. If the 13- to 16-ounce refrigerant can included in the typical kit raises pressures to nearly



A typical do-it-yourself refrigerant charging kit includes a small can of refrigerant, a charging hose and a dispensing valve. The charging hose must be connected to system's low-side charging valve. A pan of warm water (less than 125° F.) can help move refrigerant.



With the engine running at fast idle, A/C system at maximum setting, and all doors and windows closed, let system stabilize for five minutes. Then take the temperature reading at the center vent. Air temperature should be about 28° to 30° below the outside temperature during normal conditions.

easy to change on most late models. Test the blower by hot-wiring it directly to the battery with jumper cables.

A/C won't come on

If the A/C won't come on at all, a common reason is that the refrigerant has leaked out and a low-pressure protection switch has opened to keep the compressor clutch circuit from activating. With the system off, pressure in a high or low fitting should be at least 60 p.s.i. If not, have a pro recharge the system. If the pressures are normal, check the fusebox for a blown fuse and the compressor for a loose electrical connection.

On many GM cars (late 1971 through 1976 except Vega and Chevette, plus 1977-78 Toronado-Eldorado), there is a compressor clutch fuse that can prevent the clutch from engaging if it fails. Pull the fuse out of its holder and connect a jumper across the B- and C-terminals of the holder. If the compressor now runs when the system is turned on, the fuse is defective and should be replaced. This fuse is supposed to blow only when system pressures are very low, but it may also fail if engine compartment temperatures get too high.

It may take special training and equipment to do a thorough job of A/C diagnosis and repair, but as you can see, there are a lot of things you can do with only a small investment in time and money.

PM

normal, you may add a bit more to the system with a second can. Check pressures as you go along and stop adding refrigerant when low-side readings are within spec and high-side pressures are over the minimum. Whenever you stop charging with refrigerant (either for a pressure test or because you're finished), shut the dispensing valve on the refrigerant can first, then disconnect the hose from the test fitting.

If the addition of refrigerant restores performance for only a brief period, you may have a bad leak in the system. Let a pro check it. Do the same if the pressures are low on a relatively new car.

Ductwork problems

If the system passes pressure and other tests, but the air from the registers is warm, perhaps the problem is in

the ductwork. Operate the temperature control lever and see if there is any change. If not, turn off the A/C and turn on the heater. See if operating the temperature lever makes any difference in heat output. If not, perhaps the flap door it controls is stuck. Or the cable may have come off the flap door (which mixes heated and cooled air). On some cars, you can reach the cable connection at the flap door under the dash and check, freeing up a stuck flap or reconnecting the cable.

If there is no substantial volume of air flowing through the registers, the blower may not be working. Sometimes the problem is as simple as a blown fuse or two. Or, it could be in the fan switch, which is easy to remove for testing and replacement on many late-model cars. Even the blower motor is

Carefully clean the condenser of your A/C system with a soft brush and a solution of mild detergent and water.



Frame Pictures In 4 Easy Steps!

STEP 2

Glue And Clamp Sides

After you've cut your frame to size and glued it, put the clamp corners on the frame corners and tighten the nuts. The clamp squares itself and holds the frame at the right tension, so that the glue will set properly.

Our heavy-duty system will clamp any frame from 3" x 5" up to 4 ft. x 4 ft. accurately and easily. Instructions included.

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STEP 3

Cut Keyhole For Flush Hanging

Here's a clever way to set flush mounted, ever-straight pictures. Use this router bit to cut a keyhole into your frame. Slip the keyhole over a nail or screwhead and slide along the slot to lock in place. Slot is $\frac{1}{8}$ " wide; keyhole is $\frac{3}{16}$ " diameter.

6700 - Keyhole Router Bit **ONLY \$16.95**



STEP 1

Cut Frame To Size With A

Professional Miter Saw

The light saw suspension lets you cut even thin molding without tearing. The cutting edge is hardened and very thin for accuracy with little waste.

Has both a depth of cut adjustment and a right/left length stop for duplicating cuts. Detent stops lock at 22 $\frac{1}{2}$ °, 30°, 36°, 45°, and 90°; so you can even cut 5, 6, and 8 sided frames!

Table length: 17 $\frac{3}{4}$ ". Cuts up to 6 $\frac{3}{8}$ " at 90°, 4 $\frac{1}{4}$ " at 45° and up to 4 $\frac{1}{8}$ " deep. Saw is 22". Instructions included.

LN264 - Pro Miter Saw **ONLY \$99**

LN626 - Spare Blade **\$10**



STEP 4

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Don't crack your glass or mar your art by trying to hammer brads in at an impossible angle! Use our brad pliers to squeeze brads into your molding.

A rubber cushion protects your frame as you squeeze. For all moldings up to 3 $\frac{1}{8}$ " wide and 1 $\frac{3}{4}$ " deep.

A500 - Framer's Pliers **ONLY \$19.95**



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☐ Enclosed is \$1.00. Please send your full-color 1983 Catalog of Fine Tools PLUS all catalogs and new tool bulletins FOR THE NEXT TWO YEARS.

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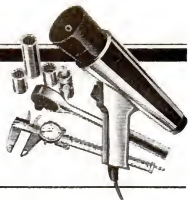
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THE PM GARAGE



Self-cleaning

Fog and driving lights are always a considerable source of help on stormy nights—until the lenses become covered with slush or some other variety of road grime.

Deco International has considered the problem and now offers a new kind of all-weather driving light. The unit is equipped with its own electric wiper and spray washer which can be operated from the driver's seat at the touch of a toggle.

Deco offers drivers a choice of fog or driving light patterns with either a clear or amber lens.

Each type of light is powered by a Halogen H-3 55-watt bulb. The lights are supplied with all mounting hardware, instructions and a protective lens cover.

The lights which I tested performed quite well, but they will cost about \$100 each.



Wiper and spray washer are built into driving lights from Deco International.

Additional information is available by writing directly to Deco International, 12612 Osborne St., Pacoima, Calif. 91331.—Joel Breault

Cuts like crazy

I still don't understand how these scissors work, but they cut an incredible variety of things: fiberglass cloth, sheet metal, plastics, leather, coolant and fuel line hoses, even a penny. One blade has a file-like surface that continually



Stainless-steel scissors for garage work cut almost anything that needs cutting.

resurfaces the other blade. The blades are offered to provide leverage.

The scissors cost \$6 at auto parts stores and are distributed by S&G Tool-Aid Corp., 43-53 East Alpine St., Newark, N.J. 07114.—Paul Weissler

Keep it clean



Wheels designed with intricate recesses can be cleaned easily with Lug Scrubber.

Just the thought of jamming my fingers when I clean around the lug nuts on my minitruck makes me cringe. Now, I avoid the pain by using Rally-Mag Car Products' Lug Scrubber. The hand-sized plastic tool has different brushes on each end. Dip the tool into soapy water, slip the end with interior bristles over the lug nut and scrub. Use the other end on recessed areas. Lug Scrubber is \$7.50 at auto parts stores. Write the maker at Box 1274, Newport Beach, Calif. 92663.—Joel Breault

Choke chiller

One problem in servicing your car's automatic choke system is to recreate either cold-start or extreme engine operating conditions. You may have to wait hours for the engine to cool down to get cold-start symptoms. Kent-Moore's Model J34024 Choke Tester works with standard compressed air systems to instantly heat or cool choke and carburetor components. The nozzle shoots out heated air from one end, or chilled air from the other. The tester is \$79.50 from Kent-Moore Tool Div., 28635 Mound Rd., Warren, Mich. 48092.—Cliff Gromer



New tester cools a hot choke or heats a cold choke for testing without waiting.

Aim-it-yourself



Adjust vertical aim of your headlights at home with a device that costs only \$13.

The cheapest professional headlamp aimer costs about \$200. Now, do-it-yourself aimers are \$12.95 at auto parts stores. There's one model for round lamps, a second for rectangulars. Each has a bubble level. Place it on the ground in front of the car and preset the tool to compensate for floor slope. Then hold it up against the lens and turn the vertical aim adjusting screw until the bubble is level again. The maker is Hopkins Mfg., 428 Peyton, Emporia, Kan. 66801.—Paul Weissler

Pall Mall A Step Ahead

Step up in taste,
step down in tar



Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

9 mg. "tar", 0.8 mg. nicotine av. per cigarette, FTC Report Mar. '83.

WORKSHOP MINICOURSE

(Continued from page 46)

transported from fingertips to work surface is probably the biggest reason for those ugly white spots on shop-made furniture.

Glue left on a wood surface acts as a sealer. This means that the stain won't penetrate the wood wherever glue has been allowed to remain. The white spot that results is, pure and simple, the mark of a novice woodworker.

The trick I use to keep my hands free of glue is to put a pile of sawdust, gathered from below my table saw, in a convenient spot on the workbench before starting a gluing session. Then, I repeatedly go to the pile, scoop up a handful, rub the sawdust between my hands and discard it in the shop trash barrel.

The dust acts just like a blotter and keeps my hands clear of spot-producing glue.

The points covered in this and my previous column focus on working with white (or carpenter's) glue—the glues that most home-shop workers are likely to use.

Both of them produce fine results when used properly. The best way to ensure doing just that is by reading the glue manufacturer's instructions on the label.

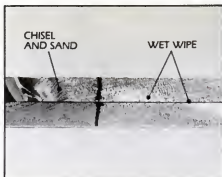
PM



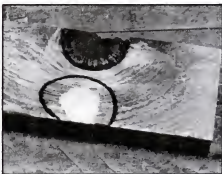
Next, sand the surface smooth, using 120-grit sandpaper. Test to see if any glue remains by dampening with water.



Carefully inspect finished projects for glue spots before staining. Here, a dab of white glue on pine, inside the marked circle, is just about invisible.



On sample board, surface to left of line had glue chiseled off. On right, it was removed with damp rag while glue was wet. Edge was then stained. It's obvious which method removed all of the glue.



If you do miss such glue spots on a surface, here is what the piece will look like after staining. Such imperfections are evidence of careless workmanship.

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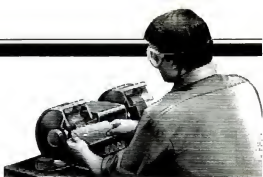
Crosman Airguns, 990 Turk Hill Road, Piquette, N.Y. 14450

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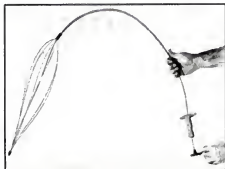
THE PM WORKBENCH



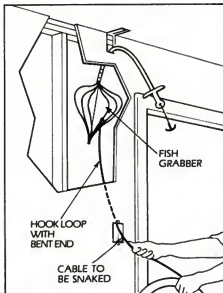
What a grabber

Called the Fish Grabber, this tool is the best that I've ever used for snaking electrical wires through walls.

The plastic-encased wire loops expand inside the wall to provide a target for the fish tape's hook end. It costs \$44.95 postpaid from Comtec Industries, 226 Robbins Ave., Rockledge, Pa. 19111.—H.W.



Fish Grabber is about 5 feet long. As the handle is retracted, the loops expand.



Insert the Grabber into the wall and expand the loops. Then, snake your fish tape in until it catches a loop. Return to the Grabber, close the loops and finish by pulling the wire through.

Economical drum sanding

Some time ago, PM reader Dave Peterson brought Singley sleeveless drum sanders to my attention.

With these drums, you cut standard sheet sandpaper to fit the drum, rather than buying expensive factory-made sleeves.

In addition, the drum's sponge rubber backing protects the sandpaper for longer wear. The manufacturer offers a wide number of fittings for use on a



With the abrasive paper wrapped around the drum and tucked into the slit, you slide the key into the oblong opening and then rotate to tighten the paper.

drill press or lathe, or in an electric drill.

At Dave's suggestion, I tried the drums and found them to be a thoroughly satisfactory method of lowering my ever-increasing sandpaper costs.

For more information and a price list, contact the Singley Specialty Co. Inc., Box 5087-PM, Greensboro, N.C. 27403.—H.W.

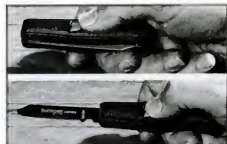


Sanding drums come in four diameters (left to right): 1-, 3-, 2½- and 2-in. dia. All drums are 3 in. long. The key tool in foreground secures the paper to the drum.

Ein gutes electrical knife

This precision German-made tool is the best electrician's knife I've ever worked with.

The tool sports a pushbutton blade and a convenient electrical screw size slotted driver at the blade's end. My



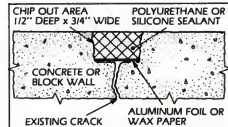
To use the knife, simply depress the button on the side of the case (top). The blade pops out and locks in place.

favorite feature is the serrated blade. With this cutting edge, it's almost impossible to cut through wire strands when stripping the insulation. It costs \$12.95 plus \$1.50 for postage and handling from Big Three Promotions Inc., 242 West 26th St., New York, N.Y. 10001.—H.W.

UPDATE

We wish to clarify a misleading passage in our story *Problem Concrete: Answers To The 17 Most-Asked Questions About Patching* (page 112, June '83), brought to our attention by the Portland Cement Assn. (PCA).

Our instructions for filling a crack in the outside of a basement wall called for chipping out an area ¾ in. wide by ½ in. deep



around the crack, lining the chipped-out area with aluminum foil or waxpaper and then filling the lined crack with polyurethane or silicone masonry sealer.

Refer to the drawing above, based on PCA's own illustration, for the right technique. Note that the bondbreaker lines only the base of the chipped-out area. **PM**

PM OWNERS REPORT:

BY MICHAEL LAMM WEST COAST EDITOR

VW SCIROCCO

"Bucket seats have wraparound comfort."

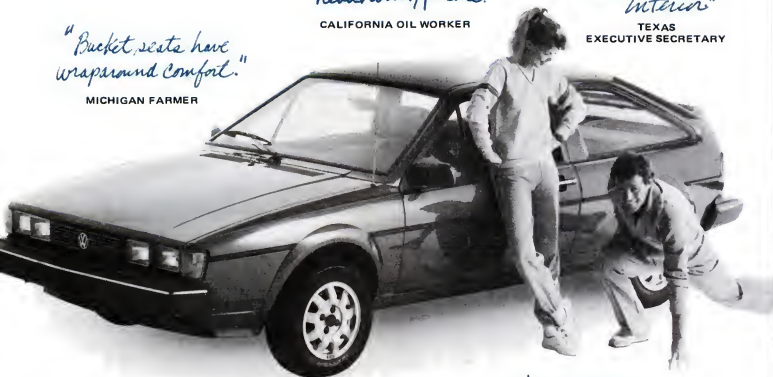
MICHIGAN FARMER

"Give us more head room, please."

CALIFORNIA OIL WORKER

"I love the shape, hatchback and interior"

TEXAS
EXECUTIVE SECRETARY



"Driving the car makes you feel good; road feel and handling are very positive."

OHIO PRICING MANAGER

"Really holds the road; very peppy."

NEW YORK
SALES ADMINISTRATOR

"More gauges, fewer idiot lights."

TEXAS COMPANY MANAGER

"Back seat is still not for adults."

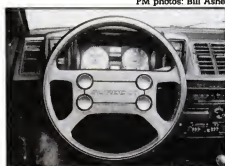
CALIFORNIA PROGRAMMER

Owners love the styling and handling, but would like to see more power.

Volkswagen launched its ponycar in 1974 and has sold over 600,000 since then.

The second-generation Scirocco with its new skin, pictured here, bowed at the Geneva auto show in March 1981. And, earlier this year, VW introduced its Wolfsburg-Edition Scirocco, which has a more powerful, 1.8-liter Four and other improvements (see *Imports & Motorsports*, page 10).

The 1.8 is rated at 90 hp, which is 16 hp more than is available from the 1.7-liter engine under the hoods of the 1982 Sciroccos owned by drivers in this survey. That's precisely why "more engine power" was the cry of these



PM photos: Bill Ashe

The four horn buttons are for thumbs, but they're tricky to use when turning.

owners who purchased their Sciroccos last year.

In terms of handling, however, the Scirocco still sets the standard in its class (see *Scirocco: Still The Car To Beat*, page 106, April '82). The Scirocco is, without a doubt, a driver's car. That in mind, we wanted to find out just

what drivers think of it—how it impresses them once they've had a chance to live with it.

First, from a Tennessee electrical engineer: "I bought my Scirocco for overall design, performance, economy and comfort—all a good value, I feel, at just under \$12,000. Quality is far superior to any American car I've owned. The Scirocco is well engineered, with

A NATIONWIDE SURVEY BASED ON 1,059,624 OWNER-DRIVEN MILES

no rattles, ill-fitting panels or paint blemishes."

A California attorney, aged 26, told us: "A friend owns one and recommended the Scirocco. I wanted a sport coupe that handles well, delivers good

gas mileage and is sharp looking. I'm getting 25 to 28 mpg around town and 34 mpg on the freeways. Now that I've put 4,300 miles on the car, I find it solidly built, good handling, economical and very pleasing to look at."

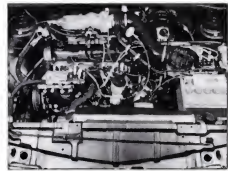
One owner told us he hated the upshift light (which lets the driver know just when he should shift to the next higher gear for maximum fuel economy) because "I hate to lug the engine."

An Alabama postal carrier reported:



The seats give good support. Leather is available in the new Wolfsburg Edition.

"I liked the styling of the Scirocco, and I've always had good luck owning other VWs—never any problems. I've had no mechanical troubles with this car, either. Quality is excellent. Everything fits, no rattles. I also appreciate the full-sized spare tire. Among my dislikes:



The 1.7-liter Four, shown here, was replaced with a 90-hp 1.8 liter spring.

price, and the transmission is hard to speed-shift. Good front seats. Good support, although they're a little hard to get into and out of."

The Scirocco uses Recaro-type front buckets, which give lateral support via wings on the sides. These wings make it hard for some people to slide in and

(Please turn to page 52)

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OWNERS REPORT: SCIROCCO (Continued from page 51)

out of the car. Once they're in, though, most appreciate the seats. Yet 9.5 percent of the owners we queried said they'd like these seats changed to something more conventional.

A retired California schoolteacher talked about his Scirocco in these terms: "I've owned over 40 imported cars during my driving career, including a gull-wing Mercedes, Bentley, Aston Martin DB2, Porsche speedster, four Alfas and a '79 Scirocco. In many ways, this Scirocco is my favorite. It's a balanced car which does everything well.

"Front comfort is excellent with those supportive seats. I bought this car for its handling, looks, quality workmanship and fuel economy. I have no complaints, but rear legroom is typical of a 2+2: minimal."

Here, again, is a point brought up by a few owners. When VW engineers restyled the Scirocco, they added 6.5 inches to overall length. None of that stretch, though, went into legroom. It all ended up toward luggage space and front overhang. Most owners realized beforehand that this car's rear seat is strictly for occasional use. However, 7.1

percent yearned for greater rear legroom.

Most owners, too, tended to be young. A New York secretary, aged 22, noted: "The Scirocco is honestly a terrific car. I do feel, however, that, given time, VW will refine it after this year's restyling. I loved the old version, but this year's car suits my taste even better. I prefer the rounder, smoother look. The ride is fabulous. It also tolerates the potholes of Manhattan quite well. For a small car, interior comfort is terrific. I feel, though, that the seats are too stiff and that the ventilation system makes too much noise."

Handling received excellent reviews. An Alabama pathologist: "Marvelous all-weather handling with fwd. It really sticks to the road, especially at high speeds. Good fuel economy, too, without that usual 'tin box' feeling. Enough storage space to be an only car, as opposed to, say, the RX7. Fit and finish comparable to the Japanese and superior to any U.S. model I examined. Even so, the car was delivered with a faulty smog valve, which caused the engine to idle poorly. The dealer repaired this at the 1,000-mile check and I've had no

problems since. I find the steering a bit heavy at low speeds, and the styling seems mediocre compared with the previous model. I'd like to look at the Renault Fuego turbo, which wasn't out when I bought my Scirocco."

Yet styling came through as the main reason for purchase. Scirocco owners tend to be design-conscious, and that's no surprise. However, one design feature irked some owners, like a self-employed Floridian who gives vent to his feelings about the Scirocco's single, centrally mounted windshield wiper. "I hate that damned wiper. Due to the single blade, the arc isn't complete. It never totally clears my [the driver's] side." We heard that same lament from 7.1 percent of our owners.

Another complaint had to do with general lack of interior space. A California dispatcher summed it up for another 7.1 percent by saying, "Overall interior dimensions leave a lot to be desired. The seats are difficult to get into and out of, there's no headroom front or rear, the instrument-panel controls are hard to reach, and I miss the old wind wings."

Still, these complaints paled when

viewed against the generally rave reviews most owners give this car. An Illinois fuel-injector lab technician, for example, glows: "I worked as a VW mechanic for nine years and fell in love with the first Scirocco I drove. I'm even more impressed with this second generation. Even at \$12,000, it's the poor man's Porsche and should be driven as

such for maximum enjoyment."

A California manufacturing manager: "I'd owned a 1977 Scirocco previously. In my opinion, VW has refined virtually all the items I thought needed refining, making the second-generation Scirocco a super all-around automobile. Quality is superb, paint is impeccable, no misalignments, nothing loose, and

drive-train reliability can't be beat. In terms of handling, performance, style, design, workmanship, fwd and engineering, the Scirocco is an all-around great car that provides the full spectrum of utility, looks and driving pleasure. Would I buy another one? You bet—unless I can afford a Porsche 944 or 928!" **PM**

SUMMARY OF 1982 VOLKSWAGEN SCIROCCO OWNERS REPORTS*

Total miles driven 1,059,624	Specific dislikes:	Comfort opinion (rear seats):	Number of vehicles owned:
	No complaints 22.7%	Excellent 4.2%	Scirocco only 39.1%
Average miles per gallon:	Shifts poorly 8.1	Good 15.0	Two cars 44.1
In town 28.3	Needs more rear	Average 21.7	Three cars 12.8
Long trips 35.8	legroom 7.6	Poor 49.1	Four or more cars 3.9
	Single windshield wiper 7.8		
	Seat shape/style 7.0	Had any mechanical trouble?	Makes of other cars owned:
Transmission choices:	What changes would you like?	No 69.9%	Volkswagen 29.4%
Manual five-speed 97.2%	More engine power 10.7%	Yes 30.1	Chevrolet 12.8
Automatic three-speed 2.8	No changes 9.5	What type of trouble?	Buick 9.2
	Better seat shape 9.5	Fuel induction system 18.2%	Ford 8.3
Why did you choose the Scirocco?	Better windshield wiper 7.1	Air conditioner 12.7	Oldsmobile 8.3
Styling 64.3%	More headroom 7.1	Transmission 10.9	
Economy 37.9	More rear legroom 7.1	Electrical system 10.9	Age distribution of owners:
Performance 28.0		Clutch 7.3	15-29 years 45.5%
Handling 27.5	Workmanship opinion:	Shifter 7.3	30-49 years 45.0
Past experience 16.5	Excellent 65.0%		50-plus 9.6
	Good 31.7	Dealer repairs satisfactory?	
Specific likes:	Average 3.3	Yes 69.0%	Would you buy another Scirocco?
Styling 62.6%	Poor 0.0	No 31.0	Yes 83.7%
Handling 59.2	Comfort opinion (front seats):	Dealer service opinion:	No 16.3
Economy 52.3	Excellent 87.8%	Excellent 31.7%	Would you buy another VW product?
Performance 35.1	Good 25.1	Good 43.9	Yes 88.9%
Comfort 32.8	Average 6.6	Average 17.1	No 11.1
	Poor 0.5	Poor 7.3	

*Percentages might not equal 100% due to rounding or insufficient data.

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STRIKING BACK AT LIGHTNING

The traditional lightning rod may be on the way out as science improves on Ben Franklin's invention.

BY DENNIS ESKOW SCIENCE EDITOR

Like a terrible bolt from Thor, the finger of bright light sizzles down to the scrubby New Mexico desert from a dark cloud hanging low in the sky. It looks like lightning, but it's no act of God.

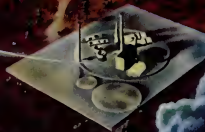
"Think of it as Ben Franklin's kite, 1980s style," says Charles Moore, New Mexico Tech's eminent lightning researcher. "We use a little rocket instead of a kite, but the rest of the experiment is much the same." The experiment consists of a wire that is grounded and hooked to the body of a French Rugieri rocket, a yard-long vehicle with a metallic tip. When shot about 1,000 feet into an electrically charged cloud, the tip of the rocket carries the base of the cloud's negative charge down to the positively charged earth. A stroke of laboratory "lightning" is induced.

In the war against lightning's destruction, scientists have launched about 80 rockets from New Mexico Tech's Irving Langmuir Labs. And they've set up scores of experiments in a search for the perfect lightning rod. Their findings promise to create a lot of static in the

Rocket tethered to earth by wire is fired into a cloud to induce a lightning strike in experiments that have raised questions about the effectiveness of traditional lightning rods. Actual rocket is shown in the inset photo.



PM photo. C. O. Hayenga



PM art. Edwin Herder



lightning protection industry, especially since Moore has branded the current-day lightning rod inadequate.

"Some of our experiments show that the only thing the pointed rod protects is itself," Moore says. "When Ben Franklin flew his kite, he correctly observed that the pointed metal object, when grounded, would draw off a local charge from the surrounding air." But, Moore adds, Franklin didn't realize that the rods can work so well as to disrupt the electric field around themselves, causing the bolt to avoid them and hit a few feet away where it can do tremendous amounts of damage. Insurance industry figures indicate that more than \$100 million in lightning damage is done every year. And the National Safety Council reports an average 100 deaths per year from lightning.

Other scientists and lightning experts agree with Moore about the failure of the traditional lightning rod, although their reasons differ somewhat. Whatever the reason, the dissidents are growing more visible as we learn more and more about lightning.

Lightning is basically the jumping of a spark between two highly energetic plates of opposite charge. What creates the charges is still open to debate. But the mechanism by which a lightning bolt is created seems to have been completely unraveled.

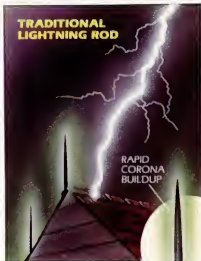
To generate a lightning stroke, nature can use a cloud that's predominantly positive or predominantly negative. Generally, the bottoms of thunderclouds are negatively charged, meaning that electrons are flying about them free of atoms and fast enough to knock off electrons from any atoms they hit.

Meanwhile, the earth's natural charge is predominantly positive. In a storm, charges build up with corresponding speed in the ground and the cloud. Thus, as a negatively charged cloud darkens the earth, a positive charge builds up and creeps along the ground, following the cloud as it moves. Why this happens is not clear, but the fact that it happens is very well established.

Like a poltergeist, the positive charge creeps upward toward the negative. But the air is a terrible conductor, so the waves of positive charge quickly collapse and roll on until they find an object—a tree, building or even a person—that will let them rise a considerable distance above the ground. Once the positive charge

(Please turn to page 118)

A typical lightning strike is created when negative electrons fall toward positive waves of particles rising from the earth (facing page). Pointed lightning rod (right) may not offer protection. It's supposed to draw surrounding charges, and lightning bolts, from surrounding air to ground. But if blue-green corona builds up on the rod too quickly, the lightning shifts and hits the roof.



Blunt rods build up their coronal discharge slowly, making them much more reliable for drawing strikes from cloud to ground. In an array of rods (right), the corona builds up slowly and over a broad area, so any lightning bolt would be likely to hit away from the protected building altogether. The blunt rod concept was advanced by Charles Moore, whose experiments cast doubt upon the pointed rod's effectiveness.



A Dissipation Array (right) uses thousands of pointed rods spread over protected area like an umbrella. With this device, charge is drawn to ground before lightning can form. A protective corona fends off lightning.



An early experimental Dissipation Array was exposed to heavy lightning field at Langmuir Labs six years ago. Blow from several return strokes destroyed array and bent one of its rods. Dissipation Arrays built more recently have outperformed all other lightning prevention devices, with no reported hits from lightning.



PM Drops The Tops Of...

THE DETROIT CONVERTIBLES

We drive the current crop, talk to owners of the Mustangs, LeBarons and Rivas, and preview new ragtops on the way.

BY MICHAEL LAMM WEST COAST EDITOR



Ford Mustang

Leading the pack, the Mustang convertible is in heavy demand, with Ford anticipating a production of 23,000 this model year.

It all began when the "last" American convertible rolled off the Cadillac assembly line in 1976. Only 200 Cadillac bicentennial ragtops were built. And while Cadillac pegged its price at \$11,049, demand was so great that some of those cars left their showrooms for nearly triple that amount. Here was, after all, the end of an era. The world shed a tear.

The world, that is, except for a few enterprising individuals and companies. From 1977 through the early '80s, convertible converters popped up like dandelions. They were centered mostly in California and Florida, but with an aggressive concentration in and near Detroit.

One of the more successful custom convertibles

became Intermeccanica's Cabrio, built in California and based on the current-generation Mustang. Ford sat up and took notice but, for the moment, did nothing.

It was Chrysler Corp. that actually resurrected the factory convertible. Ailing Chrysler needed a shot in the arm and had little to lose. To test the market for a factory convertible, Chrysler worked with Cars & Concepts, a large Detroit series-custom shop, and together they produced a soft-top K-car. They showed the prototype in a number of auto shows around the country. Result: 3,200 orders before Chrysler even knew what hit them.

For Chrysler, those 3,200 orders were only the beginning. Once production started, Cars & Con-



Buick Riviera

The Rolls-Royce of American convertibles, the Riv is a stunning \$25,000 package.



Chrysler LeBaron

It was the K-Car converts that got the ball rolling for the renaissance of the ragtop Detroit-style.

cepts couldn't keep up. Demand outraced everyone's dreams, and the factory convertible had made not just a comeback, but what amounted to Easter in Detroit.

By the time Cars & Concepts built 11,000 K-car ragtops, they and Chrysler decided mutually that it might be wiser and more economical if the parent company got back into convertible production directly. Chrysler began doing so around March 1982, when it slowly shifted assembly of the Dodge 400 and Chrysler LeBaron convertibles to its St. Louis plant.

Meantime, Ford got inspired and decided to let Cars & Concepts convert the Mustang. The result of that project bowed in November 1982 and, as of

May 1983, Ford dealers counted 20,000 firm orders for Mustang convertibles. Ford plans to produce some 23,000 during this model year.

Also in late 1982, Buick decided to broach the upper ranges of the convertible market. Buick contracted with American Sunroof, headquartered in Southgate, Mich., to begin converting Riviera coupes into Riviera convertibles. American Sunroof also converts GM J-car coupes—the Chevrolet Cavalier and Pontiac 2000, both of which are just now becoming available.

At the moment, the Riviera ragtop tops the industry in base price, at \$24,960. Next comes the Chrysler Town & Country at \$15,595, the Mustang at \$12,467, the Chrysler LeBaron at \$10,995, the

Chevrolet Cavalier convertible with a manufacturer's suggested list of \$10,990, and finally the Dodge 400 at \$9,995. Pontiac hadn't released a price for the Sunbird convertible, but it'll probably be a few hundred more than the Cavalier. These figures, of course, are all subject to change—up or down—even before you read this.

Interestingly, as convertible volume increases, prices tend to drop. In 1982, the LeBaron and Dodge 400 convertibles both carried sticker figures of \$12,600. Dodge rolled that back by a dramatic \$2,605 for what's essentially the same car. Chrysler now charges \$1,605 less for the LeBaron. Part of those reductions came from cutting out one supplier, Cars & Concepts. But you have to remember that sheer volume accounts for most manufacturing economies. On the other hand, the Riviera convertible's price rose by nearly \$1,000 between 1982 and '83.

I've owned convertibles all my driving life, which means 23 years. They have included everything from topless Model A roadsters to the 1967 Camaro convertible that I've driven for the past 14 years as everyday transportation. I currently have three ragtops in my garage, so you can see that I take fluttering canvas, bun-toasting bucket bottoms, wind whistles, raindrops falling on my pate and the other manifold pleasures of convertible masochism more seriously than most.

Nostalgia, then, had nothing to do with my visiting various dealerships to check out their latest convertibles. We haven't yet seen production versions of the newest GM J-car ragtops, but of the three cars we did inspect, the Riviera looks to have the best execution. Of course, for 25 grand it should. What distinguishes the Riv conversion is the

fact that the rear quarters aren't nearly so bulky. They don't pinch the rear bench to an unnatural narrowness. The various MoPars and the Mustang have great, fat rear side quarters to contain the vertical top mechanism and hydraulic rams.

In inspecting the Riviera, I noticed, too, that the top bows look more than a little like those on my Camaro and Firebird convertibles. They could almost interchange. I asked Fisher Body Div. about this, and a spokesman told me that while Fisher isn't presently involved in the manufacture of any GM convertible, it does backstop the engineering process and audits quality.

A lot of what you pay for in the Riviera convertible has to do with standard equipment. You get power everything, including windows and door locks, cruise control, leather upholstery, air, tilt wheel, the Delco 2000 ETR stereo and much more. The convertible's rear window is real glass, but I was a little disappointed to see the top boot use snaps instead of clips or some system that leaves bright moldings without hickeys. And at the moment, the Riviera convertible comes only in red or white, with red interiors.

The LeBaron and Town & Country soft-tops also offer long lists of stan-

dard equipment. The LeBaron's optional Mark Cross package has leather seats (as does the T & C), but all Chrysler ragtops come with air, multiple power assists, AM/FM/MX sound system, tilt wheel, speed control, wire wheel covers or alloy wheels and travel computer. The Dodge 400 convertible is essentially the LeBaron stripped. Standard engine is Mitsubishi's 2.6-liter Four, and you have your choice of five-speed manual or automatic transmissions. The rear glass on these cars is plastic, which eventually scratches and discolors.

As for the Mustang ragtop, it again has a fairly bulky top mechanism. However, it does use a no-snap boot with stiff vinyl blades that hook into the bottom of black cockpit body moldings—exactly like Chrysler's system of the early '70s. The Mustang convertible comes in two equipment levels: GLX and GT, the GT being the sporty five-liter/five-speed version and the GLX having more appearance equipment.

Ford's convertibles are finished by Cars & Concepts, which doesn't do the actual top chop, but does install the foldable roof. And, like all others, the Mustang's chassis is heavily reinforced. We'll explain just how in a moment.

In addition to reinforcements, the

The Cavalier (right) and Pontiac Sunbird (opposite page) are latest ragtops to join list of open cars from Detroit. Not yet available, but expected to be in Cadillac showrooms early next year is an Eldorado convertible by American Sunroof.



CADILLAC ELDORADO





Pontiac 2000 Sunbird convertible is shown with boot in place over top mechanism. Standard power is a 1.8-liter, ohc, fuel-injected Four.



PONTIAC SUNBIRD

soft-top Mustang has a trim panel behind the rear seat where the coupe's package shelf used to be. The decklid hinges mount to the outside of this panel, and these exposed hinges detract a little from the convertible's sleekness.

Among the Mustang's standard items are full instrumentation, reclining vinyl bucket seats, glass backlight and power disc brakes. The GT version also includes power steering, handling suspension, no-slip differential and 70-series 14-inch tires.

The Cavalier convertible uses the CS coupe as its starting point, and includes the custom interior, power windows, power steering, rear stabilizer bar, tinted glass and sport mirrors. Transaxes are a five-speed or automatic.

Built-in left

With any convertible, you worry basically about three things: 1. Does the chassis flex due to structural weakness? If so, this could eventually lead to loose doors, rattles and sloppy handling. 2. Are the seals tight against wind and weather? 3. Does the car have a reliable, simple-to-use top mechanism?

You can check for flexing by a simple experiment. You raise the top and all

windows and then park one wheel up on a curb. If you hear scraping or groaning or loud clicks from the body structure or top mechanism, you know you've got some chassis flexing. I'm happy to announce that none of the Detroit convertibles so tested showed any signs of flexing. They're as tight and rigid as any sedan.

Nor did I find any undue wind noise, whistles, or leaks at freeway speeds. I did not run these cars through car washes, which makes another good test. But I did check them very closely

around all rubber seals, including at the header and base of the backlight, and they were as tight as proverbial ticks. So, unlike some of the aftermarket convertibles we drove two years ago (see [Hardtops To Ragtops](#), page 70, July '81), these conversions are done with a great deal of attention to engineering detail.

Reinforcements

All current U.S.-produced factory convertibles begin life as unit-bodied

(Please turn to page 112)

Living With A Ragtop

To find out what it's like to live with one of the new Detroit convertibles, we spoke with over a hundred owners of Rivas, Mustangs and LeBarons and discovered some interesting facts. For example, about three out of four owners had owned convertibles before.

Why did they buy their soft-tops? "I've always been a convertible fan," said a Riviera driver. Other owners mentioned styling, fun and just plain madness.

What do they like about their cars? As you would guess, the openness, the styling, the sporty look. A Massachusetts art consultant put it this way: "This car is very popular with everyone who sees it. They usually ask if it's really a Mustang and think it's cute."

Of the Mustang owners we contacted, the average price they reported paying came to \$14,043. This, of course, included taxes, license and transportation. It excluded trade-in allowances.

We also queried LeBaron convertible owners, who paid an average of \$15,059. And Riviera owners told us they shelled out an average of \$22,833—or less than factory list.

As any perambulating fresh-air fiend will tell you, you have to put up with a lot for the joys of top-down driving. One of the Riviera owners told us, "I'd forgotten about the wind noise and rattles. I went from a practically noiseless closed car to this open Riviera. It's been fun, but I've

got a new Riviera coupe on order now. You can't relive the past."

Nor was a California architect alone in commenting, "The rear seat is too small for our dog." And several owners of all makes of convertibles reminded us of the lack of trunk space.

Ford issued a recall on its earliest 1982 Mustang convertibles when a protruding bolt ripped some of the tops. All damaged tops were replaced free of charge. Owners also told us about some problems with window adjustment. However, they're repaired under warranty.

"I live in an urban area, where I have to park on the street. I worry a lot about vandalism," noted a Texas oil scheduler. It's a problem. Insurance rates are often higher than for closed cars in many areas.

In terms of general workmanship, performance, handling, servicing and riding comfort (exclusive of noise), convertibles seem to be no different from their closed counterparts. Workmanship was judged good to excellent in all three makes.

Would these owners buy convertibles again the next time? Nearly all of them said yes. A few said maybe, but only four answered with a definite no.

Once convertible fever strikes, it's very hard to shake. As a Texas compressor operator so aptly put it, "I like to be in the wind, to meet women, to buy American. When I'm not on my Harley, I like to be in my Mustang convertible." —M.L.



Medieval Talents Finish A Century-Old Cathedral

After a century of work, the building some people call 'St. John the Unfinished' is headed for completion.

BY RICHARD DEMPEWOLFF

Chips flew as Timothy Smith, covered with gray stone dust and wielding a mushroom-shaped hardwood mallet, drove his broad boasting chisel down the length of a 250-pound chunk of limestone. "What I'm doing," he explained, "is chamfering the angled edges off this basically rectangular block. Eventually, I'll get down to the outline of the round column form you see scribed in the stone at each end." He lined up the chisel at the end for another run.

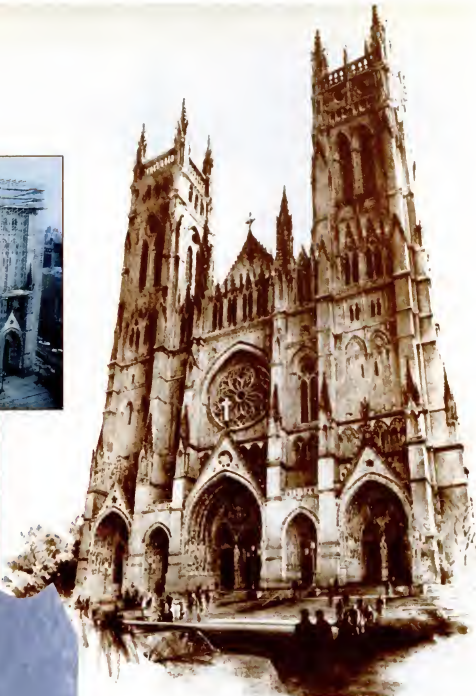
The stone was a section for a colonette, a single unit among the 24,000 hand-cut limestone building blocks that will form the two multipinnacled Gothic towers crowning the west face of the Cathedral Church of St. John the Divine in New York City. Now, after nearly a century of intermittent construction, "St. John the Unfinished," as some have dubbed it, is due for completion.

Though the church was chartered in 1873, its cornerstone was not laid until 1892, marking the first of many delays triggered by depressions, wars, controversy over design and social strife in adjacent Harlem. By 1911, the towering spaces of the central crossing and choir—in a Byzantine-spiced Romanesque plan by C. Grant La Farge—were consecrated.

In 1941, the nave and west front (minus towers) were completed in scholarly High Gothic by Ralph



Below, the west face of St. John the Divine as it looks today. The illustration (right) depicts how it will appear when the towers are completed later this decade.



The drawing below, from a 13th-century manuscript, shows stonemasons working on a cathedral. Work has changed little, with the exception of some modern machines to handle extra-large pieces of stone. Basic cutting and shaping is still done by hand (left). Cutter follows contour of a metal template like the one propped against the stone.





At left is the only piece of equipment made new for St. John's—an 8-ft., diamond-toothed reciprocating saw.

Before hand-chiseling, stone blocks are cut with a circular saw (left), reciprocating saw (above) and planer (right). Chiseling is done to specifications marked on templates drawn from plans. The template depicted in drawing (below) forms upper arch of the rose window.



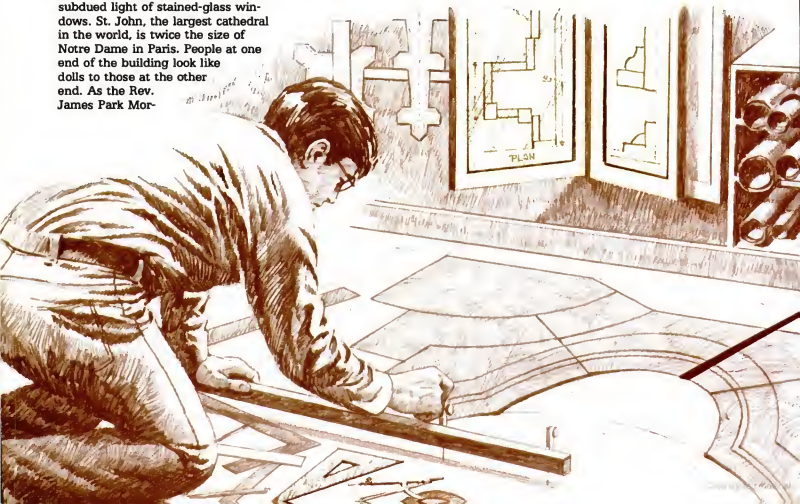
Adams Cram. Later, he revamped the choir and high altar to conform better in the curious mix of classic styles that has raised the blood pressure of many architectural purists over the years. Then World War II brought all building to a grinding halt.

Despite its garbled architecture, however, few critics today deny the breathtaking magnificence of the structure. Uniquely slender columns support the nave's sweeping arches, which soar to a high vaulted ceiling. The granite-pillared apse and choir, in multihued stone and carved wood, resemble a Renaissance painting in the subdued light of stained-glass windows. St. John, the largest cathedral in the world, is twice the size of Notre Dame in Paris. People at one end of the building look like dolls to those at the other end. As the Rev. James Park Mor-

ton, present dean of the cathedral, said, "It blows the mind."

Today, after a 38-year hiatus, stonecutters are hard at work once more. Masons are laying up hand-cut blocks to finish the twin 294-foot towers and the transepts, using techniques employed by the craftsmen who built the great cathedrals of Europe hundreds of years ago.

In 1977, with New York City on the brink of bankruptcy, the Right Rev. Paul Moore Jr., bishop of the Episcopal Diocese of New York, and Dean Morton, whom he'd tapped for the big job, convinced the trustees that the time was right to take the final plunge. The cathedral, they pointed out, had always been a "source of inspiration and community transcending



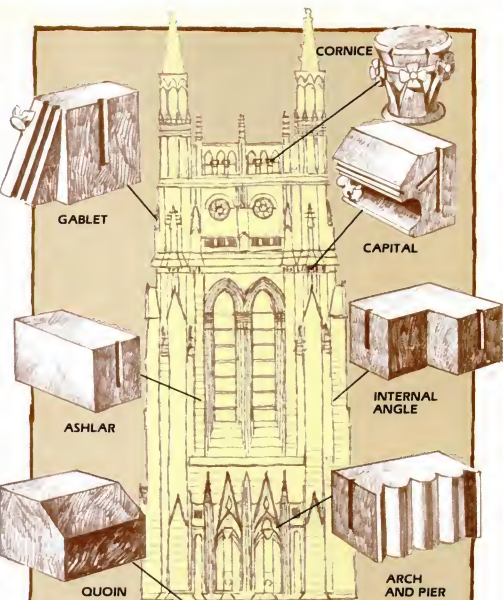
all boundaries of race, ethnic background and creed." Bringing employment and unique craft opportunities to the young people of the community would be part of the plan.

Getting the program off the ground was something else. A campaign to raise \$35 million had to be launched. In addition, use of stone for major construction had all but ended after World War II, with the advent of steel and concrete skyscrapers with curtain walls of glass and plastic. Stone advocates refer to them as wallpaper jobs. The result was that skilled stoneworkers had vanished. Through colleagues in England, Morton found and brought to New York the Liverpool Cathedral master builder, James R. Bambridge, a third-generation stoneman. Bambridge is working with Alan Bird, with whom he did rebuilding on Wells Cathedral in England. Bird, a 31-year-old master mason, now runs day-to-day operations in the stoneyard as a sort of foreman and general manager.

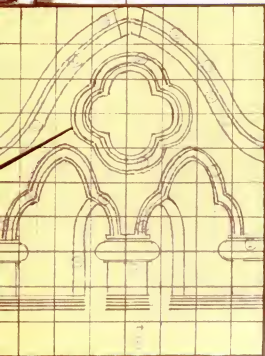
As master builder, Bambridge's job is to plan and direct the overall project. He coordinates production of working drawings from the architect's plans with the delivery of stone from the quarry, the stone's progress through the yard and its final application to the edifice.

The decision was made to train apprentice stonecutters and masons from the Harlem neighborhood, similar to the way it's been done in Britain and on the continent since medieval times. "When the news broke," Bambridge said, "we had 200 applicants to fill the first five slots. We spent a week interviewing them." Eventually, the crew in-

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Seven types of stones are being used. Above, the gablet forms elaborate bases for small towers. The ashlar is principal masonry, while quoins are cornerstones, column bases and sill bases. Cornice stones are the most intricate hand-carved parts of tower. Capitals are used in parapets. Internal angle stones form recesses in walls. Arch and pier stones are for moldings and jambs. Photo below shows stones after cutting.





ParaPlane designer Steve Snyder gives PM's outdoor editor some final instructions (above) prior to Hill's first ultralight flight. While flying the ParaPlane (right), Hill was impressed with how easy it is to control. "If you can tie your shoelaces, you can fly this," he says.

IT'S A PARACHUTE, IT'S AN ULTRALIGHT, IT'S PARAPLANE

The world's first flexible-wing ultralight is easy to fly—even for an editor. And it's fun, too.

BY RAY HILL OUTDOORS EDITOR

I was nervous. We were walking toward the world's first flexible-wing ultralight, the ParaPlane. And I was about to fly it.

"There's nothing to worry about," Steve Snyder said as we walked. Snyder is an aeronautical engineer, and the ParaPlane's designer. "This is the only propeller aircraft in the world that you can solo on your first flight," he said.

A few minutes later, I was strapped in the ParaPlane's canvas seat, staring down between my feet at my only instruments—a convex mirror so I could see the canopy over my head, and an altimeter.

"Are you ready?" asked a voice in my ear through the helmet radio. "Roger," I replied with some trepidation into the helmet's mouthpiece.

Snyder pulled the rope starter on each of the ParaPlane's two 210-cc two-cycle engines, and they came to life. He stepped back and gave me the thumbs up sign. I moved the throttle lever beneath the seat to the wide-open position with my left hand. Slowly, the ParaPlane began to roll forward. With my feet, I kept the nose wheel pointed into the wind. That was easy. A push on the right foot lever made the nose wheel turn right. A push on the left lever made the wheel turn left. Gradually, the plane picked up speed. I wondered if the Wright brothers felt like this at Kitty Hawk.

After a few hundred feet, and traveling at a mind-blurring speed of, oh, maybe 25 mph, the ParaPlane lifted off gently. I was at full throttle,

(Please turn to page 119)



Forward motion forces air into openings at the canopy's leading edge. This inflates it into a wing. Redirected air generates lift. When the plane's forward thrust is sufficient, ParaPlane lifts off. For level flight, throttle is cut back so that the lift equals the suspended weight of the ParaPlane and pilot.

Altimeter (left) sits between the pilot's legs. ParaPlane weighs 190 pounds with a full tank of gas. It can be pushed easily by one man to takeoff area. Throttle lever (below) is under pilot's seat.





Build PM's Snorkel-Tow For Lazy Summer Fun

Enjoy exciting, carefree snorkeling behind our low-cost, electric-powered tow-float made from an ordinary rubber inner tube. You can also turn it into a two-man, self-propelled fun raft.

BY SHELDON M. GALLAGER

S snorkeling is more fun if you don't have to work at it. With PM's self-propelled Snorkel-Tow, you glide effortlessly over the water as it pulls you along at a leisurely 2 to 3 mph. A face mask and snorkel are all you need to enjoy this exciting and inexpensive form of underwater exploration. You just point the Snorkel-Tow where you want to go and watch the magical world of marine life as it passes by below you.

The Snorkel-Tow is a simple inflatable float powered by a small, 12-volt trolling motor. It consists of a rubber inner tube lashed to a circular platform of $\frac{3}{4}$ -in. plywood to support the motor and battery. The motor is bolted to the



Snorkel-Tow (top) is a simple inner-tube float propelled by a small electric fishing motor. It pulls you through the water as you guide it with a rope bridle around your shoulders. Slightly larger version (above) becomes a two-man (or one-man, one-woman) powered raft for lazy fun in the sun or fishing in shallow waters. It uses the same electric motor, but has a tiller for steering. The Snorkel-Tow's motor is fixed. Either version is easy to assemble. Just strap inner tube to a circular platform of $\frac{3}{4}$ -in. plywood (left).



underside of the platform, and the battery, sealed in a waterproof plastic case, sits on top inside the ring.

You steer by means of a rope bridge that passes under your arms and around your back, leaving your hands free to collect marine specimens or operate an underwater camera. A slight twist of your shoulders is all that's required to turn the craft to the right or left.

The same basic construction can also be used to make a self-powered, sit-in raft that will accommodate two people for lazy exploration of coves and inlets or fishing in shallow waters. In this case, a larger inner tube is used for

(Please turn to page 110)

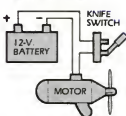


Waterproof battery case made for marine use is key to safe operation of Snorkel-Tow. Lid straps on to seal battery and prevents any chance of electrical shocks.

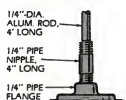


Motor is easy to mount on plywood disk because its collar is threaded to accept standard 1/2-in. plumbing pipe. A short 1/2-in. nipple and pipe flange fasten it on.

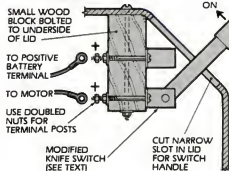
WIRING DIAGRAM



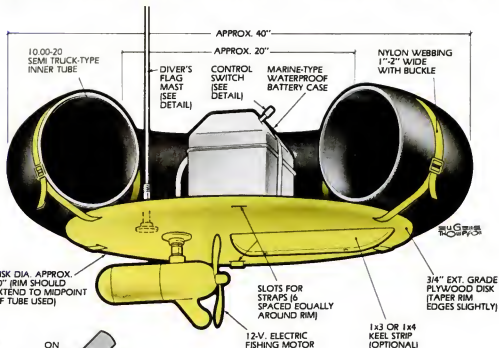
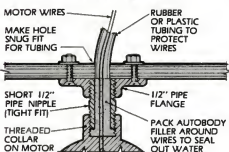
DIVER'S FLAG DETAIL



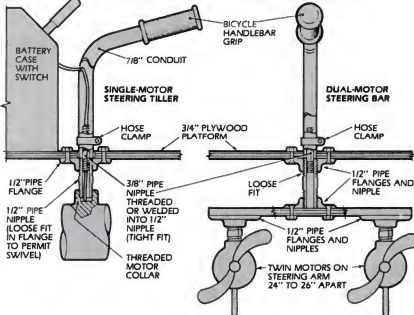
MOTOR SWITCH DETAIL



MOTOR MOUNT DETAIL



ALTERNATE MOTOR MOUNTS FOR TWO-MAN RAFT





DESIGNER PATIO TABLE

Specially designed side rails hold down tablecloth and bench covers in wind. Benches fit under table (left) for compact storage.



PM's Picks For Picnics

These outdoor dining sets can make your summer meals a real delight.

BY ROSARIO CAPOTOSTO

Summer—a time of warm weather, glowing sunsets, friends and outdoor dining. A great barbecue served *al fresco* can certainly be the highlight of anyone's summer entertainment schedule. And what better way to serve a fine meal to good friends than on a beautiful patio table you've constructed yourself?

Of the two picnic tables PM presents this month, the designer patio table is the more stylish and unusual. Architect Ira Grandberg, who designed the table, specified highly figured ash for a light yet rich look, and half-lap leg-rail joints for trim lines. The outer rails around the table and benchtops are designed to hold the tablecloth and bench covers in place, even when it's windy. Grandberg's design also provides support for a large umbrella which will shade the table.

Ash generally is available with only the faces of the boards surfaced. You'll have to dress one edge of each board before ripping them to the required widths. It's easy to joint true edges on shorter lengths, so it's a good idea to rough-cut the boards to approximate lengths before jointing.

After jointing and cutting all members to size, lay out half-lap joints for the table leg assemblies. Mark each member at the joint to indicate which parts belong together. This will prevent



TRADITIONAL SAWBUCK TABLE

Named because of its crisscross leg design, the sawbuck table is an American classic. The redwood protects against moisture damage and can be cut and shaped easily.

imperfect joints caused by mismatching.

Cut round corners at the bottoms of the table legs with a jigsaw and smooth them with a belt sander. Counter-bore recesses for screws and wood plugs with a 1/2-in. brad point bit. Dry-fit leg assemblies and note minor adjustments that may be needed. When you're satisfied with the fit, clamp parts of the leg assemblies together in position and bore shank diameter and pilot holes for No. 14 screws as indicated.

Follow exactly the directions supplied with the waterproof glue you select. Resorcinol glue, the type we used, can be proportioned by either vol-

ume or weight. If you own a postal scale, use it to measure ingredients specified for the mixture. Apply glue to both members of each joint and fasten them with screws.

The construction of the benches is similar to that of the table. Therefore, you can follow the same order of operations and build the table and benches at the same time. Glue the ledger strips to the inner side rails, leaving an offset from the top edge equal to the thickness of the stock you'll use for the slats. Tack-nail a spacer block to the exact centers of both lower end rails on the table leg assemblies. The spacer should be equal in width to the outside diam-

PM color photo: Harry Hartman
Sawbuck table photo: Simpson Timber Co.
PM how-to photos by the author

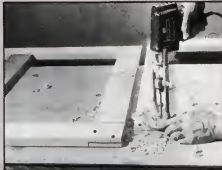
HOW-TO STEPS FOR DESIGNER PATIO TABLE



After cutting them to finished size, clamp together members for leg assemblies. Trace layout lines for half-laps.



A radial-arm saw with dado head is ideal for cutting half-laps. Crosscut blade also works, but requires more passes.



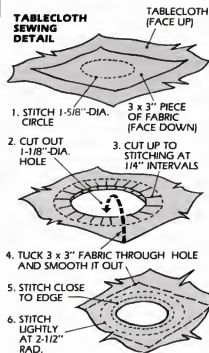
A portable drill with a guide is easier to use than a drill press when you are boring recesses for the decorative plugs.

Dry-assemble the leg units, inner side rail assemblies and stretchers



SAWBUCK TABLE HOW-TO

TABLECLOTH SEWING DETAIL



upside down, using bar clamps to hold the parts together. Check the rectangle formed by the inner rails carefully with a rafter square and make the necessary adjustments. Bore pilot holes for No. 14 screws and lagscrews through and into the rails and stretchers.

Disassemble the table and benches and round over corners with a $\frac{1}{2}$ -in.-radius bit as indicated. Do not round the upper rails of the leg assemblies. Be

(Please turn to page 122)

Sawbuck tables and benches made from redwood have become America's traditional outdoor dining furniture for two reasons: They're attractive and they're durable.

Redwood is endowed with natural preservatives that protect it against damage from moisture. It also is soft, so it can be cut and shaped easily with basic hand and portable power tools. We suggest using clear-grade redwood for this project.

Start by cutting lengths for the table legs (B) from 2×4 stock. Lay out angle cuts at the top and bottom of each piece using a protractor and T-bevel. Or simply cut them on a radial-arm saw or table saw with a miter gauge.

Once the legs are cut, pair them up. Crisscross both pairs at their centers and bore a $\frac{1}{4}$ -in. hole through the exact centers where they overlap. Fasten each pair temporarily with a $3\frac{1}{2}$ -in. bolt.

Cut the table cleats (D) from 2×6 stock and tack-nail them to the temporary leg assemblies so the top corners of the legs meet the top corners of the cleats. Then, trace the edges where the legs overlap in pencil to lay out areas where stock needs to be removed to form half-lap joints. Mark each part so you'll be able to tell which pieces belong together, then take the temporary assemblies apart and cut the half-lap joints.

Reassemble the legs permanently, using $\frac{1}{4} \times 2$ -in. carriage bolts with flat

washers and nuts. Attach the cleats to the legs with $\frac{1}{4} \times 3\frac{1}{2}$ -in. carriage bolts after boring the appropriate holes.

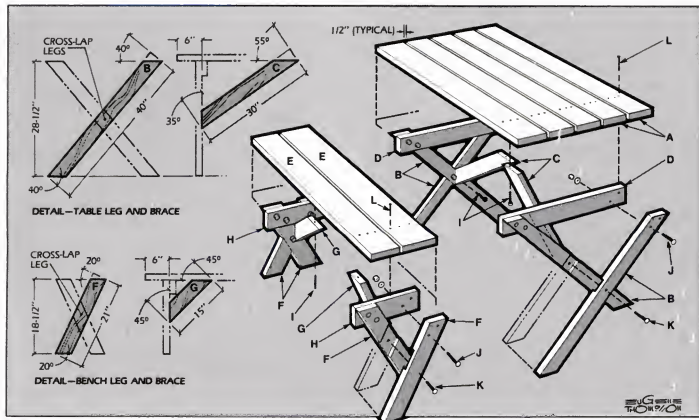
Attach tabletop slats (A) to the cleats with 10d galvanized nails. The first slat should overlap the cleat end by $\frac{3}{4}$ in. and the slat ends should overlap cleats by 4 in. Leave $\frac{1}{2}$ -in. spaces between slats for an overall tabletop width of $29\frac{1}{2}$ in. Cut and fasten the table braces with $\frac{1}{4} \times 3$ " lagscrews. Note that braces must be positioned off center on the legs because of the carriage bolts that join the legs.

Assemble the benches using the same layout methods and procedures. If you want the redwood to retain its original color, apply a redwood stain. Otherwise, it will weather to a gray color.—P.S.

MATERIALS LIST— TRADITIONAL SAWBUCK TABLE AND BENCHES

Key	No.	Size and description (use)
A	5	$1\frac{1}{2} \times 5\frac{1}{2} \times 60$ " redwood (tabletop slats)
B	4	$1\frac{1}{2} \times 3\frac{1}{2} \times 40$ " redwood (table legs)
C	2	$1\frac{1}{2} \times 3\frac{1}{2} \times 30$ " redwood (table brace)
D	2	$1\frac{1}{2} \times 3\frac{1}{2} \times 28$ " redwood (table cleat)
E	4	$1\frac{1}{2} \times 5\frac{1}{2} \times 60$ " redwood (bench seat slats)
F	8	$1\frac{1}{2} \times 3\frac{1}{2} \times 22$ " redwood (bench leg)
G	4	$1\frac{1}{2} \times 3\frac{1}{2} \times 15$ " redwood (bench brace)
H	4	$1\frac{1}{2} \times 3\frac{1}{2} \times 12$ " redwood (bench cleat)
I	12	$\frac{1}{4} \times 3$ " lagscrew
J	32	$\frac{1}{4} \times 3\frac{1}{2}$ " carriage bolt with washer and hexnut
K	6	$\frac{1}{4} \times 2$ " carriage bolt with washer and hexnut

Misc.: 10d hot-dipped galvanized nails.



New Life For Old Yard Furniture



The final step in restoration is to apply several coats of tough, clear finish. This darkens the redwood and brings out a deep, rich color.

Don't discard your tired redwood outdoor furniture. Instead, restore it to mint condition. Here's how.

BY ROSARIO CAPOTOSTO PM photos by the author

Decaying, dilapidated yard furniture is hazardous to use and an eyesore, as well. If this describes the condition of your redwood furniture, read on for PM's restoration remedy.

By combining the right technique with a little effort, you can restore crumbling furniture to a structurally sound, safe state. Some redwood yard furniture has fallen into ruin because of the popular misconception that redwood can resist decay naturally. This is true only in heartwood grades. Sapwood grade redwood is no more immune to decay than any other wood species. Most store-bought yard furniture is constructed of sapwood grade. So, unless it's maintained properly and refinished every few years, sapwood redwood will eventually rot.

Salvaging a picnic table

Begin by completely disassembling the table and benches. Use a penetrating oil to help loosen rusted nuts and bolts. Then, carefully remove nailed-on members with a pry bar. Save and reuse all parts that are still sound.

Examine all pieces carefully, removing any nails or screws as you go. Also, check for embedded thumbtacks and staples once used to hold down tablecloths. Next, scrub the boards clean of all dirt and grime, using a wire brush. Then, use a hand plane (or planer) to dress the boards' surfaces down to clean wood.

Chemical treatment

After planing the boards, you may find weather-darkened stains on the



Before restoration. This is the crumbling redwood table that we started with.

wood surfaces. If you intend to use a clear finish, you should remove these stains chemically. For a table receiving a paint or an opaque stain finish, it's not necessary to treat the boards chemically. Such finishes will cover most surface discolorations.

Use trisodium phosphate (TSP), available at hardware stores, to remove weather-darkened stains. Mix one cup



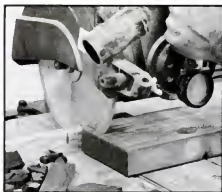
Use a penetrating oil to help loosen rusted nuts and bolts. As a last resort, hacksaw off stubborn nuts. Discard and replace rotting wood members.



Remove all grime and peeling finish from the old boards by using a wire brush.



Plane each board to a clean wood surface. Be sure to remove all the nails first.



For reuse, trim off decaying and split ends from the table and the bench slats.



Remove weather-darkened stains with trisodium phosphate. Place the boards in polyethylene-lined trough during chemical treatment. Then, remove and rinse each board of all residual chemicals.



Shape the table and bench slats' top edges with a 1/2-in. rounding-over bit. The rounded edges deter splintering.



Decayed sections of these three legs were routed out and replaced with wood patches (inset). Use waterproof resorcinol glue to make all repairs.



Glue wood filler strips into the legs' cross-lap joints to compensate for wood stock lost during planing. Hold the glued strips in place with masking tape.



Wood members deteriorated beyond repair, like these cleats, must be replaced. New replacement pieces are frequently stronger and safer than original ones.

of TSP to one gallon of warm water. Caution: Always mix and use chemicals outdoors, while wearing safety goggles and rubber gloves.

Make a simple trough to hold the boards while applying the chemical solution.

First, nail together a 2x4 frame sized to hold the longest board. Then, line the frame with polyethylene. Place a board into the trough and brush on the TSP solution liberally. The polyethylene liner will contain any solution runoff. Then, use a stiff-bristle household brush to scrub the solution into the wood. Remove the board from the trough and hose it down. If stubborn stains are still visible, bleach them out with an oxalic acid solution.

To make the solution, dissolve four ounces of oxalic acid in one gallon of warm water. Then, brush the acid solution onto each board. Allow the boards

to dry before hosing them off. Pure oxalic acid is available at many hardware stores and pharmacies. An oxalic acid substitute is also available, but isn't recommended for use on redwood.

After the wood has dried, use a router with a 1/2-in. rounding-over bit to ease the top edges of the table and bench slats. Then, belt sand each board to remove all planing marks.

Reconstruction

Table and bench components that are badly deteriorated must be replaced. However, wood members that are decaying just in small areas can be salvaged. Use a router with a mortising or straight bit and carve out the rotting section from the board. Now, cut a wood patch to fit into the routed cavity. Hold it in place with waterproof resorcinol glue.

If an appreciable amount of wood was planed from the bench and table legs, the cross-lap joints won't fit as tightly as they should. Reinforce the legs by gluing wood filler strips into the joints to compensate for the stock that was planed off.

To combat rust, reassemble the table and benches with hot-dipped, galvanized fasteners.

Refinishing

Apply a clear, gloss exterior finish, such as Varathane's exterior liquid plastic (No. 92). Apply the first coat thinned 10 percent with paint thinner. Then, apply three full-strength coats, allowing the finish to dry between applications.

It's important to apply the finish to all surfaces. Total coverage locks out moisture and prevents the finish from lifting off the wood's surface.

FM



To carve wells in this candy tray, the workpiece is held in a jig and the well outlines are routed. Then, the field in each is routed by moving the workpiece back and forth.



Discover The PIN ROUTER With PM's Master Craftsman

Let this revolutionary tool turn your portable router into a precision shaping system.

BY ROSARIO CAPOTOSTO PM photos by the author

The router is considered by many craftsmen to be the most versatile and necessary power tool in their shop. In conventional handheld use, the router can perform a wide variety of operations. Here, we'll show you how to increase your router's usefulness and your woodworking skills by mounting the tool to a pin router assembly.

The assembly looks and operates somewhat like a drill press. The router is mounted in a carriage positioned over the worktable. The depth-adjust-

ing handle raises and lowers the carriage to obtain the desired depth of cut.

The most essential part of the pin router is the $\frac{1}{4}$ -in.-dia. steel guide pin that projects from the worktable's surface. The guide pin is held in the pin block, which is adjusted to center the guide pin directly under the router bit. When the workpiece edge is moved against the guide pin, the cutter shapes the edge accordingly. One advantage of pin-guided routing is that controlled,

uniform shaping is possible using pilot-less router bits.

Also, when using cutters with $\frac{3}{16}$ -in.-dia. solid pilots, the problem of edge burning is eliminated. The larger $\frac{1}{4}$ -in.-dia. guide pin creates a gap between the unprotected workpiece edge and the spinning pilot.

Template pin routing

Template-guided routing is the most popular pin router function. Templates of $\frac{1}{4}$ -in. hardboard serve as patterns,

allowing you to make exact repetitive cuts with ease, speed and accuracy.

Cut the template to the desired shape and nail it to the workpiece's underside. As the guide pin follows the template, the desired shape is cut into the top surface of the workpiece.

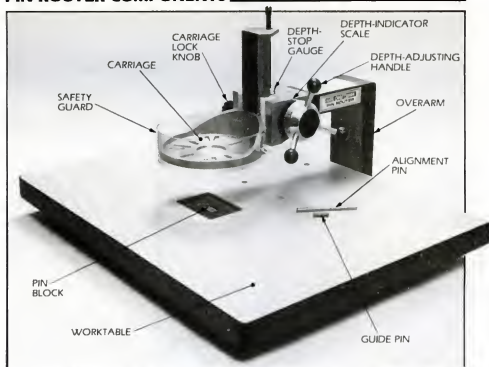
Templates can be used for partial and full-edge trimming of workpieces. When full-edge trimming, cut the workpiece slightly larger than the template. Then, steer the template along the guide pin (which, remember, is aligned with the cutter) to trim the overhanging workpiece edge flush with the template.

Other template cuts include surface carving and surface grooving. Surface carving requires templates with interior cutouts.

First, place the template over the guide pin, corraling the pin within the cutout. Then, lower the cutter into the workpiece and use freehand movement to carve out the workpiece's surface. The trapped guide pin prevents cutting beyond the template's borders.

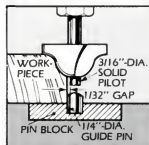
Surface-grooving templates are used

PIN ROUTER COMPONENTS

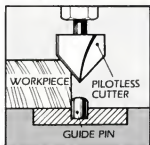


Pin router assembly is shown here minus the router, with its parts identified.

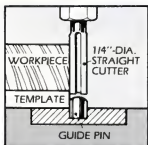
BASIC ROUTING TECHNIQUES



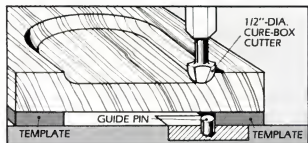
The guide pin creates a gap between the workpiece and the bit's pilot to prevent edge-burning.



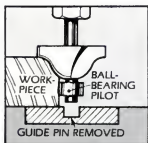
With the guide pin controlling the workpiece, uniform shaping is possible with pilotless cutters.



Attach a template to workpiece's underside for full-edge trimming. Depth-of-cut equals edge thickness.



For surface carving, place guide pin against the template's inside edge. Enclose the guide pin completely for carving the workpiece's center section only.



Remove the guide pin from pin block when using ball-bearing piloted cutters.

to cut curved grooves across a workpiece's surface. This method employs two templates spaced $\frac{1}{4}$ in. apart forming a channel.

Pass the workpiece over the guide pin, steering the pin into the template's channel. The confined guide pin will keep the workpiece on track, preventing any off-course drift from taking place.

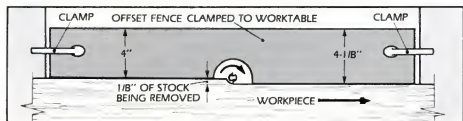
Ball-bearing piloted routing

When using router bits fitted with ball-bearing pilots, no template is needed, so remove the guide pin from the worktable. After setting the router's depth of cut, steer the workpiece's edge along the ball-bearing pilot. The bearing will serve to guide the workpiece, thus establishing a uniform cutting edge.

Fence-guided routing

With the pin guide removed and a fence clamped to the worktable, the pin router performs much like a stationary shaper. The fence guides the workpiece to produce a variety of straight cuts, such as rabbets, dados, grooves and mortises.

Full-edge jointing is possible, using an offset fence. Cut the fence's receiving end wider than its feed end (see drawing). The offset compensates for the amount of stock being removed by the cutter, and work is fully supported for its length. Use a $\frac{1}{4}$ -in.-dia., double-flute straight cutter and don't offset the fence more than $\frac{1}{8}$ in. Avoid trying to remove too much stock at once or you will dull the cutter and overload the



Overhead view of edge-jointing with an offset fence. Remove the guide pin and use a double-flute straight cutter. Fence is cut to support the workpiece for its entire length.

SETUP AND ADJUSTMENT



Before you mount the router to the carriage, be sure to remove plastic soleplate.



Use the alignment pin for locating the router bit's exact center. Loosen the pin block's screws. Then shift the guide pin directly under the alignment pin.



Use the knurled depth-stop gauge to control the plunge-cut depths accurately.

SHAPING A PEDIMENT



Two cutters are used to shape the pediment's molded crown. Rout the first pass with a beading cutter. Here, the second pass is being made with a cove cutter.



Close-up of pediment shows overhanging workpiece trimmed flush to the template. Righthand side has not been trimmed.



Cut the crown sections from the workpiece and nail them to pediment's back panel. Let top edges overhang $\frac{1}{16}$ in.

ROUTING A DECORATIVE FRAME



Remove the guide pin from the pin block when using ball-bearing piloted cutters.



To shape the frame's outside edge, simply steer it against the ball-bearing pilot.



Rout the glass recess into the frame's back inside edge with a rabbeting bit.

PIN ROUTING PROJECTS



The depth-indicator scale is ruled in $\frac{1}{32}$ -in. increments to give fine adjustments.



Projects shown prior to shaping: pediment with dual templates, picture frame (which needs no template) and candy tray with surface carving template.



Completed projects: carved candy tray, pediment with built-up molded crown and oval picture frame that was shaped with ball-bearing piloted cutters.

SURFACE CARVING



Use a straight cutter to trim the crown's top edge flush with the back panel.



Nail the candy tray's surface carving template to the workpiece's underside.



Close-up of pediment's top edge shows how the overhanging crown is trimmed.



Keep the guide pin against the template cutout's inside edge to groove the perimeters of each candy tray compartment.



Make the final leveling passes with the router set for extremely shallow cuts.

router, with possible damage to the motor as a result.

Setting up the router

The first step in setting up a pin router is mounting the router to the carriage support plate. First, remove the plastic soleplate from the router's base. Routers without soleplates are always mounted as is. **Caution:** Always unplug the router before mounting, making adjustments and changing the cutter bit.

The next step is adjusting the guide pin to align with the cutter bit. The Sears pin router shown comes with a steel alignment pin that's used for this purpose.

First, chuck the alignment pin into the router. Then, lower the carriage, using the depth-adjusting handle until the alignment pin is $\frac{1}{4}$ in. above the guide pin. Tighten the carriage lock knob to hold the carriage in this position. Now, adjust the pin block so the guide pin is directly under the align-

ment pin. To check for precise final alignment, remove the guide pin and lower the carriage until the alignment pin enters the guide pin hole. If necessary, readjust the pin block to achieve perfect alignment.

Pin routing projects

Here are techniques and procedures for making three projects—a pediment (ornamental crown detail) using dual templates, a candy tray employing a surface carving template and a picture frame shaped with ball-bearing piloted cutters.

Whenever routing, regardless of the technique or type of cutter used, always feed the workpiece against the rotation of the cutter bit. Also, notice that for photo clarity the pin router's plastic safety guard has been removed. During actual routing operations, you should always set the guard $\frac{1}{4}$ in. above the workpiece.

Pediment—A pair of hardboard templates are used to make the pediment.

Cut one template to match the outline of the pediment's back panel. Shape the second template to conform to the built-up molded crown's inside curve. Transfer the shapes of the templates onto two boards. Then, rough-cut the boards $\frac{1}{8}$ in. larger than the templates' outlines. Now, tack-nail the templates to the underside of their respective boards. Use a $\frac{1}{4}$ -in.-dia. straight bit to trim the rough-cut boards flush with the templates.

Two cutters are needed to shape the molded crown's profile. First, rout the crown's lower portion, using a $\frac{3}{4}$ -in. beading cutter. Then, install a $\frac{3}{8}$ -in. cove cutter to form the profile's concave upper portion. Now, cut the crown from the board to match the top outline of the pediment's back panel. Cut the molded crown in half to form the left and right side crown molding. Glue and nail the crown pieces onto the pediment's back panel, allowing the top edges to overhang $\frac{1}{8}$ in. Trim the ped-

(Please turn to page 118)

Garden Shed That Complements Your Yard

BY ROSARIO CAPOTOSTO

PM photos by the author

This eye-catching structure stores lawn and garden supplies without giving up any plant space.

Here's a compact garden tool shed that provides storage space for a lawnmower, a seeder and many other garden implements. The roof is a planter which can hold potted flowers or evergreens.

This handsome shed is sided with Texture 1-11 plywood panels that are cut and joined to form a distinctive herringbone pattern. Two deep shelves at the rear hold bottles and cans. The design is adapted from a concept by the Georgia-Pacific Co. For security, we installed a self-latching gate latch with a padlock eye on the door.

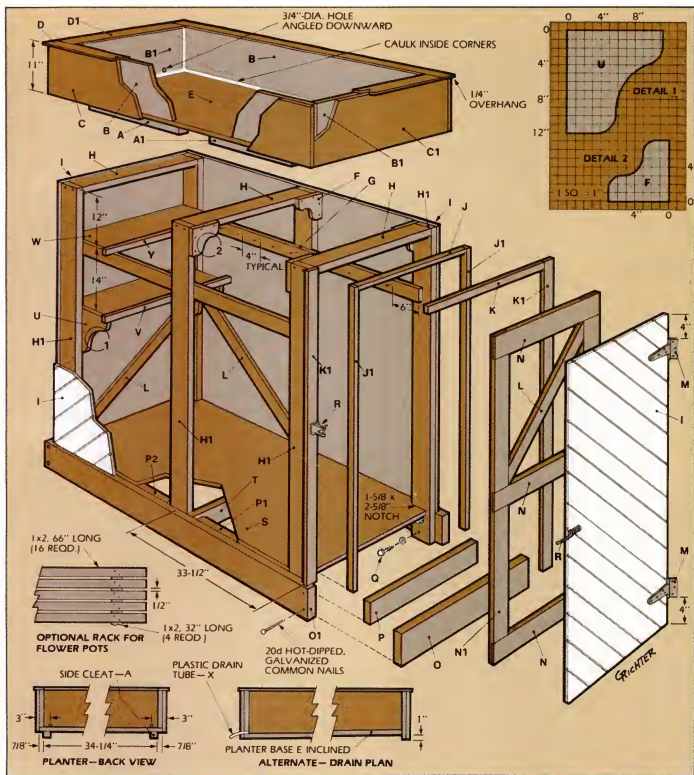
The roof planter drains off excess

water through two drain holes at the rear of the box. Two short lengths of plastic tubing in these holes project several inches to prevent rainwater from running down the walls.

There are two ways to pitch the planter's floor to obtain positive water drainage to the rear. The simplest

method is to prop the front of the entire shed slightly upward, either on treated wood blocks or by grading the site. An inch or so will do it and the tilt will hardly be noticed. The alternative is to construct the planter box with the bottom plywood panel inclined about 1 in. from front to back (see alternate drain plan in the drawing).

Your lawnmower simply wheels out of the shed and is ready for use or for servicing.

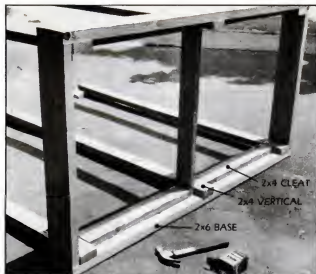


MATERIALS LIST—GARDEN SHED

Key	No.	Size and description (use)	H	3	1 1/2 x 3 1/2 x 31" pine (cross brace)	P1	2	1 1/2 x 3 1/2 x 26" pine (floor cleat)
A	2	1 1/2 x 1 1/2 x 28 1/4" pine (siding cleat)	H1	6	1 1/2 x 3 1/2 x 72 1/2" pine (frame)	P2	2	1 1/2 x 3 1/2 x 28" pine (floor cleat)
A1	2	1 1/2 x 1 1/2 x 26 1/4" pine (siding cleat)	I	3	5/8 x 4 x 8' T1-11 siding	Q	12	5/16 x 2 1/4" lagscrew and washer
B	2	3/4 x 10 x 68 3/4" pine (planter side)	J	1	3/4 x 3/4 x 31" pine (doorstop)	R	1	Rust-resistant latch*
B1	2	3/4 x 10 x 34 1/4" pine (planter ends)	K	1	1/2 x 1 1/2 x 31" pine (trim)	S	1	3/4 x 34 x 66" exterior plywood (floor)
C	2	5/8 x 10 1/4 x 70" MDO plywood (planter sides)	K1	2	1/2 x 2 1/2 x 67" pine (trim)	T	1	1 1/2 x 3 1/2 x 34" pine (frame cross brace)
C1	2	5/8 x 10 1/4 x 35 3/4" MDO plywood (planter ends)	L	3	3/4 x 2" x length to suit pine (bat-ten)	U	2	3/4 x 1 1/4 x 12" pine (shelf support)
D	2	3/4 x 1 1/2 x 70 1/2" pine (cap)	M	2	5" heavy-duty, rust-resistant tee hinge*	V	2	3/4 x 1 1/4 x 34" pine (edging)
D1	2	3/4 x 1 1/2 x 34 1/4" pine (cap)	N	3	3/4 x 3 1/2 x 30 3/4" pine (door frame)	W	2	3/4 x 1 1/4 x 31" pine (shelf)
E	1	3/4 x 35 3/4 x 68 3/4" exterior plywood (planter bottom)	N1	2	3/4 x 3 1/2 x 65 1/4" pine (door frame)	X	2	3/4 x 1 1/4 x 31" pine (shelf)
F	4	3/4 x 7 x 7" plywood (gusset holder)	O	2	1 1/2 x 5 1/2 x 34" pressure-treated pine (base)	Misc. 1	20d (4-in.) hot-dipped, galvanized common nails; wood preservative; caulk; resorcinol glue; paint or stain.	
G	2	3/4 x 2 1/2 x 65 1/4" pine (tool holder)	O1	2	1 1/2 x 5 1/2 x 70" pressure-treated pine (base)			
			P	2	1 1/2 x 3 1/2 x 31" pine (floor cleat)			

*Hardware is by Stanley Hardware, Div. of The Stanley Works, New Britain, Conn. 06050.

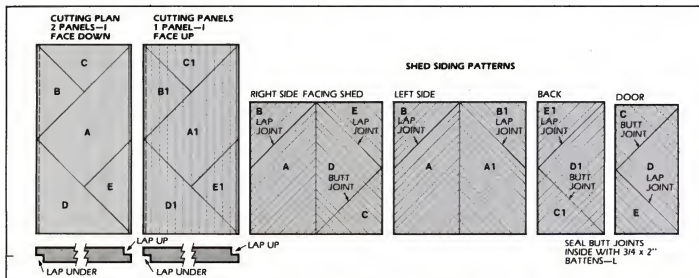
*Hardware is by Stanley Hardware, Div. of The Stanley Works, New Britain, Conn. 06050.



First, join the 2x6 base. Blunt the nail points to avoid splitting the wood. Attach 2x4 verticals with lagscrews, then set the 2x4 floor panel cleats flush with the top edges of the base. The next step is to add the end cleats (P).



Parts from the first panel are used as templates for tracing the parts on the third panel. Put the third panel face up and the templates face down. The panel edge laps must match, not mate. You should use a clamped straightedge to guide the angle cuts.



It may be most convenient to construct the shed close to your workshop, or perhaps on your driveway. However, keep in mind that the completed unit is rather heavy and will require four people with strong backs to move it to its final site. If this is not feasible, consider partially assembling it on solid ground, then finishing it at the installation site.

Use pressure-treated lumber for the ground contact base and vertical frame members. Begin by cutting to size the 2x6 stock (parts O and O1, see materials list). Fasten the parts with 20d hot-dipped galvanized nails. Use hot-dipped galvanized fasteners throughout the construction. Either blunt the points or bore pilot holes in the outer members only, to avoid splitting the wood.

The 2x4 verticals (H1) are added next. To obtain maximum rigidity, use lagscrews (Q) in lieu of nails to join the verticals to the base. The textured siding panels (I) dictate the height of the

unit. You can, however, gain an inch or so in headroom by increasing the length of the vertical 2x4s specified in the materials list, which we did. You can fill the resultant gap between the top edges of the siding and the bottom of the planter with solid wood strips.

When the verticals are in place, add the 2x4 cleats (P, P1, P2) for the plywood floor. Next, cut the 2x4 cross members (H and T) to size and nail them in place. The floor panel (S) is notched with a sabre saw to fit around the 2x4s.

Make the planter box by cutting parts and nailing the box ends (B1) and sides (B) to the plywood bottom (E). Then face the ends and sides with 5/8-in. MDO plywood (C and C1). Before assembling the box, all surfaces and edges should be treated with wood preservative. After assembly, bore the holes for water drainage and apply preservative to the wall of the holes. Let the preservative dry for several days.

If you view the planter from an ele-

vated deck, you may want to apply several coats of deck enamel paint to the inner box. Then apply a bead of caulking to all seams of the box. Cap the top edges of the box with 1/4-in. trim (D and D1) to keep water from the seams.

Cutting the shed's angled siding sections (I) to size requires careful layout and sawing. Cut the panels with a portable circular saw. Note that the siding panels are milled along the sides with an over and under lap. It is important to orient the three panels properly during the layout (see cutting plans on this page). Two panels are cut identically while one must be cut with the layout reversed left to right—that is, a mirror image. This will result in sections that can be arranged in a herringbone pattern. If you keep the lap edges in proper order during layout, mated lap joints will result in most of the angled joints.

All the cutting lines are either 45° or 90° angles. Therefore, the only layout (Please turn to page 113)

TEXAS
INSTRUMENTS
TI-99/4A

RADIO SHACK MODEL III

KAYPRO 10

EPSON HX-20

TIMEX
1000

COMPUTER HARDWARE

Choosing The Computer That's Right For You

There are so many computers on the market, at so many prices, that it's easy to get lost in a storm of claim and counterclaim. Here's straight talk on how to buy a computer that's right for you.

Everyone wants you to get personal with computers. If you're ready to buy, perhaps you've realized that ads really don't give you all the specs on personal computers, or, as they're also called, microcomputers. Yes, it's true that these machines can do wonders. With one, you can balance a checkbook, keep track of a monthly budget, control appliances in your house, file recipes and keep reminders of birthdays. They are powerful pieces of equipment. But it makes little sense to spend thousands of dollars for a

machine to file recipes or balance your checkbook when you can spend only a few hundred and accomplish the same things. If you're interested primarily in games, then it also makes little sense to spend a fortune for a microcomputer.

So, what should you do? First, consider the reasons you'll be buying the machine. Will you be using it to learn, play games, keep track of household records and finances, or for business purposes? When you've considered the reasons, the next step is to wade through all the conflicting claims. You're

going to need patience and persistence to find the machine that's right for you.

For the first-time buyer who's interested in learning about what makes a computer and programming tick, a good buy is the Timex 1000 or Commodore VIC-20. With both, there are programmed instruction courses which will lead you through the ins and outs of programming and computers.

If your primary interest is in simple game playing, with a minor amount of personal computing on the side, then any of the low-cost home computers,



**TRS-80
MODEL 100**

**ATARI
1200XL**

such as the Texas Instruments TI-99/4A, Radio Shack TRS-80 Color Computer or, again, the VIC-20 would be the ticket. These systems feature enough expandability to satisfy most demands and they can become flexible learning machines. You should be able to live with cassette program input, using your TV as the video output device.

However, if you're more serious about applying a computer to a variety of home, game, learning or business

tasks, then consider machines such as the Apple IIe, Commodore 64 or IBM Personal Computer, all with at least one disk drive for storage. Microcomputer disks speed up program loading and are far more convenient to use and store than cassette tapes. There's a wide variety of software and hardware, including remote appliance control, telephone communications and electronic diagnostic work.

For the serious computerist, a second drive is a must. It eliminates the need to switch disks constantly in and out of one drive. Memory expansion, to the maximum your budget will allow, is also a good idea.

If you want color graphics, then consider a color monitor and color driver card (if needed). This is especially important in statistical analysis work. However, these extra options will boost the cost of the basic machine well over \$3,000 in many instances.

In all cases, if you want to learn more about the computer, be sure it is programmable in BASIC. This way, you'll be able to write your own programs.

Here's a more detailed look at some of the systems on the market.

\$100 to \$500

You'll find two types of microcomputer in the \$100 to \$500 range—the calculator-style machine (for less sophisticated business uses) and the learning/home/games machine.

In general, the calculator-type microcomputer is more limited in its functions than the learning/home/games machine. Typically, it will interface with some type of mass storage system, such as a cassette recorder, for storing program data, and it will use a one-line liquid crystal display to show the results of a programming effort. These machines have only limited amounts of memory and are best used for engineering tasks and as learning tools. Although their attributes vary somewhat, their keyboards are arranged in typewriter style and some of them also

Top-of-the-line computer systems like those here provide plenty of power. Text and charts detail why you might choose the Radio Shack Model 100 (for its portability), IBM-PC (for expandable memory), or Apple IIe (for high-resolution color), to cite a few examples.

PH photos:
Bill Ashe

SYSTEMS FROM \$100 TO \$500

Manufacturer	Model	Price	Market	Keyboard	Display	Memory	Language	Applications
ATARI	Atari 400	\$299	Home	Membrane	TV	16K (expandable)	BASIC ASSEMBLER PILOT	Games/Home
COMMODORE	VIC-20	\$200	Home	Typewriter	TV	5K (expandable)	BASIC	Games/Home
MATTEL	Aquarius	\$200	Home	52 calculator- type keys	TV	12K (expandable)	BASIC	Games/Home Learning
MULTITECH ELECTRONICS	MPF II	\$399	Home	48 calculator- type keys	TV	90K	BASIC	Games/Home
PANASONIC	JR-200	\$350	Home	65 calculator- type keys	TV	48K	BASIC	Games/Business Home/Learning
RADIO SHACK	TRS-80 Pocket Computer 1	\$128	Home/ Bus.	65 mini-keys	24-char. LCD	1,424-step	BASIC	Games/Business
	TRS-80 Pocket Computer 2	\$200	Home/ Bus.	65 mini-keys	24-char. LCD	4K-12K (expandable)	BASIC	Games/Business
	TRS-80 Pocket Computer 4	\$70	Home/ Bus.	63 mini-keys	10-char. LCD	5K (expandable)	BASIC	Games/Business
	TRS-80 color	\$400	Home	52 calculator- type keys	TV	24K (expandable)	BASIC LOGO ASSEMBLER PILOT	Home Learning Business
SHARP	PC-1211	\$160	Home/ Bus.	65 mini-keys	24-char. LCD	1,424	BASIC	Games/Business
SHARP	PC-1500	\$220	Home/ Bus.	65 mini-keys	24-char. LCD	3.5K (expandable)	BASIC	Games/Business
SPECTRA VIDEO	SV-318	\$230	Home	65 calculator- type keys	TV	64K	BASIC FORTRAN COBOL	Games/Business Home/Learning
TEXAS INSTRUMENT	TI-99/2	\$100	Home	Plastic type	TV	31K	BASIC	Home/Games Learning
	TI-99/4A	\$375	Home	Typewriter	TV	16K (expandable)	BASIC ASSEMBLER LOGO	Home/Learning
TIMEX COMPUTER	1000	\$70	Home	Membrane	TV	9K (expandable)	BASIC	Games/Learning
	2000	\$150	Home	40 calculator- type keys	TV	32K (expandable)	BASIC	Home/Games
VIDEO TECH	VZ-200	\$100	Home	46 calculator- type keys	TV	16K (expandable)	BASIC	Home
	Creativision	\$159	Home	Membrane	TV	16K (expandable)	BASIC	Games/Home Learning

SYSTEMS FROM \$500 TO \$1,000

Manufacturer	Model	Price	Market	Keyboard	Display	Memory	Language	Applications
ATARI	Atari 800	\$649	Home	61 keys	TV	16K	BASIC	Home/Games Learning
COMMODORE	Commodore 64	\$595	Home/ Bus.	65 keys	TV	64K	BASIC FORTH PILOT LOGO	Home/Games Learning/Bus.
	Commodore 64	\$894	Home/ Bus.	64 keys	TV	64K (disk drive included)	BASIC	Home/Business Games/Learning
EPSON- AMERICA	HX-20	\$795	Home/ Bus.	64 keys	TV	64K	BASIC	Business
NEC	PC-8001	\$995	Home/ Bus.	84 keys	TV/ CRT	32K	BASIC FORTRAN PASCAL	Home/Business Games/Learning
PANASONIC	RL-H1000	\$600	Home/ Bus.	65 mini-keys	24-char. LCD	2K	BASIC	Home/Business
	RL-H1400	\$600	Home/ Bus.	65 mini-keys	24-char. LCD	4K	BASIC	Home/Business
RADIO SHACK	TRS-80 Model III	\$999	Home/ Bus.	65 keys	Built-in CRT	16K	BASIC	Home/Business Games/Learning
	TRS-80 Model 100	\$799	Home/ Bus.	Standard	LCD	8K	BASIC	Home/Business

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feature built-in calculator keyboards.

Learning/home/games machines include the Atari 400, Commodore VIC-20, Timex 1000, Video Technology VZ-200, Mattel Aquarius, Video Technology Creativision, Multitech Electronics Micro Professor MPF II, TI-99/4A, Panasonic JR-200, Timex 2000 and Radio Shack TRS-80 Color Computer. These machines are programmable in BASIC and have keyboards ranging from plastic membrane-style to full typewriter-style. They can all be expanded into much more powerful systems and they use your television set for display.

\$500 to \$1,000

Stepping up in bucks allows you to choose from a wide variety of micro-computers. They range from the calculator-style Panasonic RL-H1000 and RL-H1400 to the briefcase-style Radio Shack TRS-80 Model 100 and Epson HX-20 to such home/business machines as the Radio Shack TRS-80 Model III or the Commodore 64.

The new breed of briefcase-style computers deserves special comment. Actually self-contained, these units have full typewriter keyboards and use liquid crystal displays. Interestingly, the

SYSTEMS FROM \$1,000 TO \$2,000								
Manufacturer	Model	Price	Market	Keyboard	Display	Memory	Language	Applications
APPLE	Apple IIe	\$1,395	Home Bus.	Typewriter	TV	64K	BASIC	Home Learning Business Games
	Apple IIe	\$1,990	Home Bus.	Typewriter	TV/CRT	64K (disk drive included)	BASIC LOGO	Home Learning Business Games
ATARI	1200XL	\$1,395	Home Bus.	60 keys	TV	64K	BASIC PLOT	Home Business
COMMODORE	Commodore 64	\$1,785	Home Bus.	64 keys	TV/CRT	64K (2 disk drives included)	BASIC	Home Business
HEATH	H-89	\$1,399	Home Bus.	84 keys	Built-in b&w CRT	48K (disk drive included)	BASIC FORTRAN PASCAL	Home Business
IBM	IBM-PC	\$1,335	Home Bus.	83 keys	TV	64K	BASIC COBOL FORTRAN PASCAL ASSEMBLER	Home Business Learning Games
NON-LINEAR SYSTEMS	Kaypro II	\$1,795	Business (portable)	82 keys	Built-in 9" CRT	64K (2 disk drives included)	BASIC	Business
OSBORNE	Osborne I	\$1,795	Business (portable)	81 keys	Built-in 5" CRT	64K (2 disk drives included)	BASIC	Business
RADIO SHACK	TRS-80 Model III	\$1,849	Home Bus.	65 keys	Built-in b&w CRT	48K (disk drive included)	BASIC CP/M COMPATIBLE	Home Learning Games Business

Radio Shack unit uses a multiline LCD, which makes it into a full, portable business system.

Learning machines also have their place in this price range. The Atari 800 is more powerful and flexible than the 400 and has more versatility because of its typewriter-style keyboard. It can be used both as a learning tool and as the basis of a powerful home system.

Some powerful home/business systems have their origins in this price category. They include the Commodore 64, Panasonic RL-H1000 and Radio

Shack TRS-80 Model III. These machines are capable of handling not only household chores, but also such business tasks as word processing. They have expandable memories, which means they can handle more complex routines and feature the ability to use disk drives for mass storage. The TRS-80 Model III includes its own display tube in a single enclosure.

\$1,000 to \$2,000

Here the home machines get down to business. Serious business. Key-

SYSTEMS FROM \$2,000 TO \$3,000

Manufacturer	Model	Price	Market	Keyboard	Display	Memory	Language	Applications
APPLE	Apple IIe	\$2,385	Home Bus.	Typewriter	TV/CRT	64K (2 disk drives included)	BASIC	Home Learning Business Games
BASIS	Basis 108	\$2,150	Home Bus.	Typewriter	CRT	64K (disk drive included)	BASIC	Home Business
COMMODORE	Commodore 64	\$2,064	Home Bus.	64 keys	TV/CRT (Color CRT added)	64K	BASIC	Home Business Games
COMPAQ	Compaq	\$2,995	Home Bus. (portable)	IBM-PC style	CRT	64K (disk drive included)	BASIC FORTRAN COBOL PASCAL	Home Business
EPSON-AMERICA	QX-10	\$2,995	Home Bus.	Typewriter	CRT	64K (disk drive included)	BASIC	Home Business
HEATH	H-89	\$2,294	Home Bus. (int)	84 keys	Built-in b&w CRT	48K (2 disk drives included)	BASIC FORTRAN	Home Business
IBM	IBM-PC	\$2,104	Home Bus.	83 keys	TV	64K (disk drive included)	BASIC COBOL FORTRAN PASCAL	Home Business Learning Games
	IBM-PC	\$2,784	Home Bus.	83 keys	CRT added	64K (disk drive included)	BASIC	Home Business Learning Games
RADIO SHACK	TRS-80 Model III	\$2,295	Home Bus.	65 keys	Built-in b&w CRT	48K (2 disk drives included)	BASIC	Home Business Learning Games
TEXAS INSTRUMENTS	Professional Computer	\$2,595	Home Bus.	Typewriter	CRT	64K (disk drive included)	ASSEMBLER FORTRAN COBOL PASCAL	Home Business
ZENITH DATA	Z-100	\$2,899	Home Bus.	108 keys	CRT	28K (disk drive included)	BASIC	Home Business

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But for the home computer owner, it's another story. First of all, some of the best computer games require more than fast reflexes, can run for months, and aren't available at arcades. And very few stores will let you really try out a game before you buy. So for the most part, you've had to plunk down \$30, \$40 or more...and simply hope for the best!

Until now.

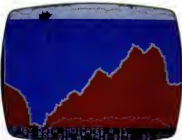
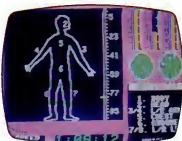
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Only if a game meets all of these requirements does it win our approval. And then we back it up with this guarantee: if you're not completely satisfied with the games you've purchased, simply return them to us within one week in resalable condition. POPULAR MECHANICS will refund your payment, promptly and in full!

Our first four selections are ready for your examination. Why not tell us now, via the coupon below, which ones you'd like?

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The year is 1990. You are the pilot of a miniaturized medical submarine inside the body of a critically injured patient. The mission: to ward off attacking bacteria, hemorrhages and possible brain damage to save your patient's life! A medically accurate, completely fascinating game.

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For Apple II/IIe (48K). Item No: 0041

For Atari 400/800. Item No: 0042

OIL BARONS. One Disc. Price: **\$39.95**, plus \$1.95 for shipping & handling.

For Apple II/IIe (48K). Item No: 0031

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The Super Fone is less than 1" thick. The base unit has a built-in speaker phone, a fully independent intercom and is 110 volt-220 volt switchable.



Until now, cordless phones have given you wonderful convenience. But they've had two problems:

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2. Some of them sound as though you're talking inside a barrel.

As cordless phones have become enormously popular, another problem has arisen: two people, living near each other, can have the same channel. Not only is there line confusion, but someone else can literally make a long distance call on your phone.

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Range: 1500 Feet OR MORE!

The SuperFone 650 uses state-of-the-art electronics to bring you the ultimate cordless phone. Sound quality is superb — and it stays superb. 1500 feet or more from the base station. That's more than twice the distance of standard cordless phones.

Only SuperFone 650 has a secret code system to prevent interference and false operation of the phone. You choose from 512 possible "code" combinations. Both the base unit and the phone are locked onto that code, which you can change when you want to.

No other phone can interfere. No other unit can share the signal. No one else can hear or speak on your carrier-wave.

Enormous Range

We say the SuperFone 650 has a range of 1500 feet.

Notice we didn't say "up to" or "as far as" 1500 feet. There's no hedging, because this seems to be the minimum, not the maximum range.

Users report 1800 and 2000 feet. That's nearly half a mile. SuperFone 650 is a radiophone, not a toy, and that's why its signal doesn't break up or start hissing or crackling when you get half a block away.

You can tell when you heft it. It's a Little Giant. You can feel the power inside. What a marvel of electronic engineering it is! And it's tough, too. It fits into your shirt pocket, and you can bounce it around all day without damaging it.

Speakerphone, Intercom — Everything!

SuperFone 650 is The Everything Phone. Anything any phone can do, it can do.

First, the base station is a speaker phone. Touch a button and you can have a hands-free conference conversation in the room in which the base station sits.

Next, it's an intercom. You can page the handset from the base unit and have a private conversation. You have a true wireless intercom, not just a signal.

Third, you have a privacy button. Push that button and you'll still be able to hear anything the other party says, but he or she won't be able to hear you until you take the button off "hold."

Fourth, you have an automatic redial. Touch the key and the SuperFone will redial the last complete number.

What else? A security switch which makes it impossible for anyone to call out on the remote phone, without changing the ability to receive calls. A volume control for the speaker on the base unit. A call button to page the base from the cordless phone. THIS PHONE HAS EVERYTHING!

30-Second Installation

Plug your SuperFone 650 into any wall AC outlet. Push its standard modular terminal into the telephone plug. You're in business.

Every component is heavy-duty, from the built-in condenser microphone (with automatic gain control) to the LED indicator lights. This phone is designed for hard use.

The SuperFone 650 is yours for **\$249.95** in regular pulse-dial version, **\$269.95** in Touch Tone®. If you want the SuperAntenna with it, giving you a range of a mile — or even more — you can have both for **\$319.95** (rotary pulse) or **\$339.95** (Touch Tone). Or you can get the SuperAntenna alone for **\$79.95**.

We Absolutely Guarantee!

Use the SuperFone 650 (or any electronic instrument you acquire from us) for up to 30 days. If for any reason you decide not to keep it, return it for a 100% refund.

The SuperFone 650, rotary pulse dial — **\$249.95**
phone and SuperAntenna — **\$319.95**.

The SuperFone 650, Touch Tone dial — **\$269.95**
phone and SuperAntenna — **\$339.95**.

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Add \$4.50 per total order for shipping.

Rotary Phone or Touch Tone®? SUPERFONE Is Available For Either!

Most cordless phones work on "pulse" (rotary) only. You can't use them for MCI, Sprint, or any of the other systems requiring TouchTone — including talking to a computer.

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(Touch Tone model slightly higher.)

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The SuperAntenna will give you cordless phone, regardless of make or model, three times the range it has now.

If the range is 700 feet, it'll leap to over 2,000. If it's 1500 feet, it could be as far as one mile!

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boards, for instance, now feature standard typewriter keys rather than calculator-type keys, plastic mini-keys or membranes.

Powerful systems such as the Apple IIe and the IBM Personal Computer are in this category along with the full-feature portables. Atari also has a more powerful home computer in this price range, the 1200XL, which includes a disk drive. This machine can be used for business, home, games and learning.

All-in-one computers abound in this price classification. They're split between the traditional-looking computer workstation-type units such as those from Radio Shack and portables. These machines feature large amounts of memory, full keyboards, possibly a disk drive or two and a built-in video display device. They can handle such tasks as business bookkeeping and planning, as well as word processing.

Portable microcomputers are rela-

tively new. They are sold as full-feature systems consisting of two disk drives for storage, complete business software, video display tube and cabinet.

\$2,000 to \$3,000

It's in this category that microcomputers become truly professional systems, as memory and functions combine to produce machines which are capable of handling complex tasks. Here, machines generally include about 64,000 bytes of memory (64K). These machines nearly always include one or two disk drives for mass storage.

Four machines are worth closer examination.

The first one is from Texas Instruments—the Professional Computer. At \$2,595, this machine includes one disk drive, has a full-travel, typewriter-style keyboard and is programmable in high-level languages. Another powerful system is Epson-America's QX-10, aimed primarily at the home/business user. It includes a special word processing and financial program called Valdocs, and one drive. The QX-10 is a total package, capable of handling a budget, personal letter or business books. A powerful portable is the Compaq, an IBM-PC compatible unit, which uses the same type of software and

hardware as the PC. It is aimed primarily at the business user. A PC work-alike, the new Zenith Z-100 is in this price category, too. With one drive, it's equipped to be programmable in BASIC and can handle both business and home tasks.

\$3,000 and up

The personal computers over \$3,000 usually include two drives in the total package.

The machines are fully decked out and can handle tasks requiring large amounts of data storage. The Apple IIe and the IBM-PC with two drives each would be examples of computers in this price range. The machines here use video display monitors, and they can perform graphics functions. Generally, these machines are aimed at the business market rather than at the home user.

When you go over the \$4,000 mark, you'll find the all-business machines such as the IBM-XT (Extended), Zenith Z-100 and Radio Shack's TRS-80 Model 16. This group includes far more memory and advanced capabilities than the average home or small business would normally need.

Now, use our charts to find your own dream machine.

PM

SYSTEMS FROM \$3,000 TO \$5,000

Manufacturer	Model	Price	Market	Keyboard	Display	Memory	Language	Applications
BASIS	Basis 108	\$3,085	Business	Typewriter	CRT	64K (2 disk drives included)	BASIC	Home Business
COMPAQ	Compaq	\$3,599	Home Bus. (portable)	IBM-style	CRT	64K (2 disk drives included)	BASIC FORTRAN COBOL PASCAL	Home Business
DIGITAL EQUIPMENT	Rainbow 100	\$3,495	Home Bus.	84 keys	CRT	64K (2 disk drives included)	BASIC C	Home Business
	Professional 325	\$3,995	Business	103 keys	CRT	256K (2 disk drives included)	COBOL CROMIX RATTOR FORTRAN	Business
	DECMate II	\$3,740	Business	103 keys	CRT	256K (2 disk drives included)	PASCAL CP M	Business
IBM	IBM-PC	\$3,363	Home Bus.	83 keys	CRT	64K (2 disk drives included)	BASIC FORTRAN COBOL PASCAL	Home Business Games Learning
	IBM-PC-XT	\$4,995	Home Bus.	83 keys	CRT	131K (2 disk drives included)	BASIC COBOL FORTRAN PASCAL	Home Business Learning Games
KAYPRO	Model 10	\$3,000 (est.)	Home Bus. (portable)	71 keys	CRT	10-Mb hard disk (included)	BASIC	Business Home
NORTH STAR	Advantage	\$3,999	Business	87 keys	Built-in CRT	64K (2 disk drives included)	BASIC	Business
RADIO SHACK	TRS-80 Model 12	\$3,199	Business	82 keys	Built-in b&w CRT	80K (disk drive included)	BASIC	Business
	TRS-80 Model 12	\$3,999	Business	82 keys	Built-in b&w CRT	80K (2 disk drives included)	BASIC	Business
	TRS-80 Model 16	\$4,999	Business	76 keys	Built-in CRT	128K (2 disk drives included)	BASIC	Business
TEXAS INSTRUMENTS	Professional Computer	\$3,100	Home Bus.	Typewriter	CRT	64K (2 disk drives included)	BASIC FORTRAN COBOL	Home Business
ZENITH DATA	Z-100	\$4,099	Home Bus. (all-in-one)	108 keys	CRT	128K (2 disk drives included)	BASIC	Home Business



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Build PM's Computer Workstation

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COMPUTER GUIDE

This three-piece desk keeps everything neat and gives you plenty of room to work.

We assembled a state-of-the-art home computer system. Then we went shopping for a desk to put it on—and discovered that you simply cannot buy a desk/table/workstation which is functional, attractive, inexpensive and ergonomically correct—that is, designed to put the components in the proper positions for the most comfortable use. So we designed and built our own. The result is this modular, ergonomic computer workstation which can be custom-tailored to your requirements. It's easy to build, extremely versatile and will fit comfortably in almost any home office. It can even be built in sections and added to as your needs grow.

Our workstation doesn't look especially high-tech. We did that deliberately, because we want it to blend in with your home decor and not look like a refugee from the starship *Enterprise*. Yet this home computer center is more advanced than any office workstation we've seen. It's filled with clever features, most of which are hidden from view.

Our computer is an Apple IIe, with a single disk drive and optional joystick. In addition to Apple's black and white monitor, we added a Panasonic ETR 300 color monitor for games and graphics. Our printer is a Gemini 15. The dimensions of our workstation modules were determined by the size of

Construction: Gerry Gerber; PM color photo: Harry Hartman
Set styling: Gabe Henrick; Furniture: Conran's, New York, N.Y.



Three-piece design (above) makes our computer desk the best all-around workstation we've seen. Storage module, left of the main desk, holds everything from manuals to disk cases (photo, right). Desk module holds color and black and white monitors, as well as computer and disk drive. Printer module to the right of the main desk has shelves for printer and paper.



Surge-protected power strip (top) is our power station on the main desk. Opening the printer module's top (above) lets you load the paper.



into a filtered power strip available at most electronics stores. The pencil drawer is optional, or can be switched to the other side of the desk.

The printer unit

The printer console is designed to hold a Gemini 15 or similar printer. Measure your printer and modify the dimensions accordingly. The console holds the printer on a fixed shelf, accessible from both front and top through the lift-up, counter-balanced lid. An optional window lets you check print quality without opening the soundproof lid.

Beneath the printer there's room for paper storage, accessible from the front of the console. A box of continuous-feed paper fits behind the paper storage.

Output paper falls onto a shelf behind the printer. This can be adjusted for the proper fall, has a lip to get the paper stack started and can be removed for



Our three modules can also be used in a straight-across configuration. You'll need more room with this arrangement.

these components, plus basic ergonomic measurements (see *How To Think Ergonomically* on the next page).

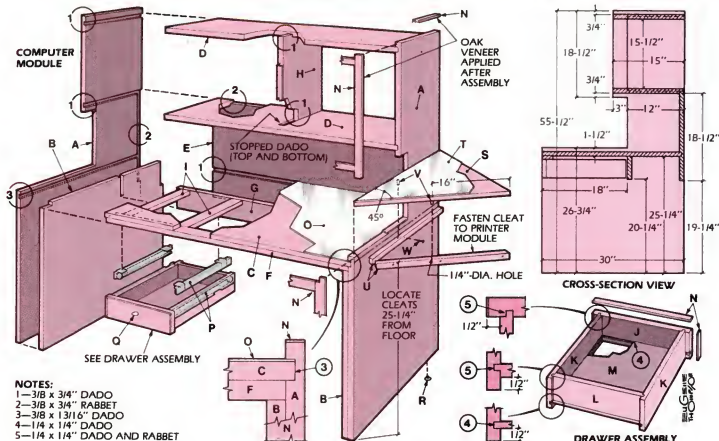
The heart of the workstation is the terminal desk. If your space or funds are limited, you can build just this unit to support your keyboard, disk drives and monitor. If you have just one CRT, you can make your desk a bit narrower than ours, although a desk for a single CRT still should be about 30 inches wide.

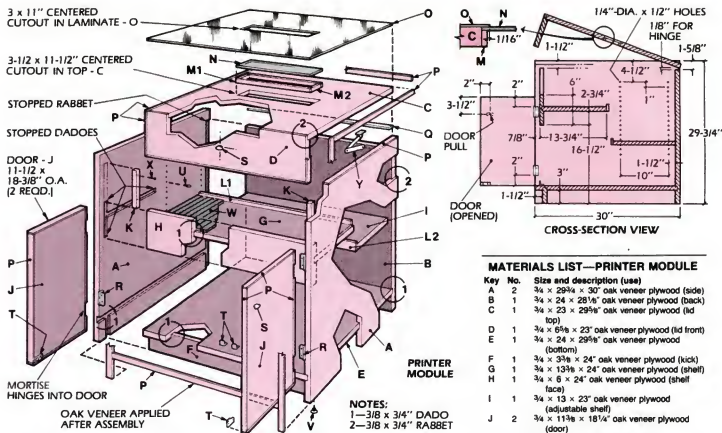
Otherwise, all the dimensions of our terminal desk are tailored to suit the computer. You'll need to measure your system components before modifying our plans. The most important dimensions are the height of the home row keys, the height of the CRT and the distance between your eyes and the screen.

In order to support the weight of two CRTs, it was necessary to suspend the CRT shelf from a top shelf using a central divider. If your system includes two CRTs, you must use both the top shelf and divider. All wiring is hidden behind the back, and we brought everything

MATERIALS LIST—COMPUTER MODULE

Key	No.	Size and description (use)	L
A	2	$\frac{3}{4}$ x 30 x 55 1/2" oak veneer plywood (side)	1 $\frac{1}{2}$ x 2 1/4 x 9 1/2" lauan mahogany plywood (drawer back)
B	2	$\frac{3}{4}$ x 25 1/4 x 30" oak veneer plywood (inside end panel)	M 1 $\frac{1}{4}$ x 8 1/2 x 17" lauan mahogany plywood (drawer bottom)
C	1	$\frac{3}{4}$ x 29 5/8 x 39 1/4" particleboard (desk top)	N 1 1/8" oak veneer
D	2	$\frac{3}{4}$ x 15 x 39 1/4" oak veneer plywood (top and bottom shell)	O 1 $\frac{1}{8}$ x 29 5/8 x 39 1/4" plastic laminate*
E	1	$\frac{3}{4}$ x 18 7/8 x 39 1/4" oak veneer plywood (back)	P 1 pr. 16" center drawer slide
F	1	$\frac{3}{4}$ x 2 x 39 1/4" pine (top support)	Q 1 Brass drawer pull
G	1	$\frac{3}{4}$ x 5 x 39 1/4" pine (stretchers)	R 4 Floor guide
H	1	$\frac{3}{4}$ x 12 1/4 x 16 1/4" oak veneer plywood (divider)	S 1 $\frac{3}{4}$ x 23 x 30 x 30" particleboard (removable shelf)
I	2	$\frac{3}{4}$ x 2 x 16" pine (cleat)	T 1 $\frac{1}{4}$ x 23 x 30 x 30" plastic laminate*
J	1	$\frac{3}{4}$ x 3 x 10" oak veneer plywood (drawer front)	U 2 $\frac{3}{4}$ x $\frac{3}{4}$ x 27" pine (cleat)
K	2	$\frac{1}{2}$ x 3 x 17 1/4" lauan mahogany plywood (drawer side)	V 2 $\frac{1}{4}$ "-dia. x 1" hardwood dowel
			W 8 1/4" No. 10 tin screw
			Mica: Carpenter's glue, linseed oil, paste wax, contact cement.
			*Formica brand plastic laminate, tidal sand No. 917.



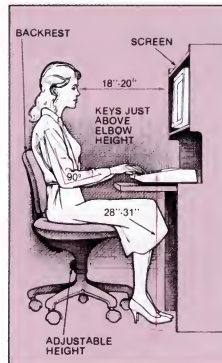


The printer console can be positioned next to the terminal desk along the same wall, turned 90° to make an L, or as we show it, on a 30° angle. We filled the gap with a removable triangular shelf which matched the terminal desk for height. If you select the L, a square filler piece adds extra space that's perfect for holding a telephone or disk-storage carousel.

Our rolling storage cabinet matches the printer console. It can be pushed back against the wall or rolled forward

next to you. The bottom drawer is sized to hold two rows of standard ring binders, and the drawer sides are cut down so you can read the spines easily. The top drawer holds disk-storage boxes—three rows of 5 1/4-inch disks or two rows of 8-inch disks.

Tucked beneath the top is a pull-out writing surface. And behind the drawers is a hidden compartment accessible only by removing the drawers. It's perfect for a small safe or fireproof storage box for valuable papers. The casters



How To Think Ergonomically

The whole point of a custom-designed workstation is to ensure maximum comfort. You may have to modify the dimensions to accommodate your equipment and yourself. These guidelines will help.

Start with your chair. It should have an adjustable seat, lumbar (lower back) support and backrest. Armrests should be removable, if you have them at all. Adjust the chair so that when you sit erect, with feet flat on the floor, your thighs are parallel to the floor.

The home row keys of the keyboard should be at or just above your elbow height when you're seated properly. Usually, this means from 28 to 31 inches from the floor.

Remember to leave enough room for your thighs under the desk top. About 95 percent of American men require 25 1/4 inches from the floor to the bottom of the desk top for leg clearance, and 25 inches generally is considered the minimum. The angle between your upper and lower arms should be 90°, through a range of 80° to 120°, up or down.

The position of the CRT is especially critical if you expect to avoid eyestrain. The top

of the screen should be at or just below the horizontal plane of your eyes when you're sitting in the erect position. The center of the screen should be 10° to 20° below the horizontal plane of your eye height, and the bottom of the screen within 40°.

Perhaps most important of all, the distance between your eyes and the CRT screen should be 18 to 20 inches. The screen should never be more than 27 inches from your eyes. Printed text should be the same distance from your eyes as the screen.

The biggest cause of eyestrain is glare from the CRT. You can minimize this by keeping your work area at a low ambient light level—between 500 and 700 lux—using indirect lighting. For printed material, use adjustable spot lighting.

Ideally, your work area should be 68° to 72° F. and 30 to 40 percent humidity. Bright colors are distracting. Neutral colors should be used, especially for the desk top. Even under the best conditions, working at a computer for six hours without a break is about the limit. Otherwise, you risk eyestrain.

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are hidden behind the recessed kick panel.

Our workstation is easy to build. The sides of each unit are higher than the tops, so that you have only a simple butt joint to make. There are no curves to cut, and all of the major surfaces—the tops, sides and backs—are formed from a single piece. All hardware is available at any hardware store.

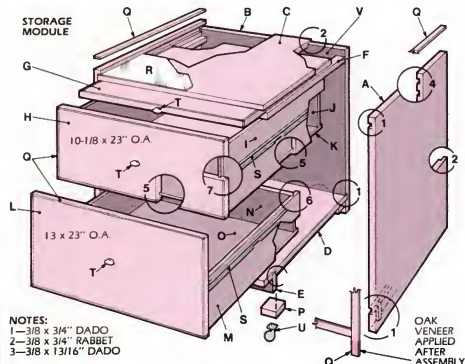
We built our workstation of oak cabinet grade plywood with Formica brand plastic laminate tops. You could use solid hardwood or solid pine throughout, but costs will mount. Painted plywood would make a functional substitute. Don't use an oil finish for surfaces which may come in contact with floppy disks. Laminate is best, though polyurethane varnish or paint are okay.

With our ergonomic guidelines, you'll end up with furniture that's as advanced as the computer it holds.

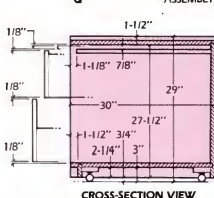
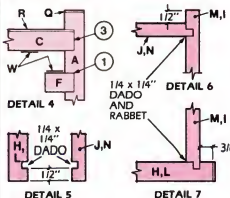
MATERIALS LIST—STORAGE MODULE

Key	No.	Size and description (use)
A	2	3/4 x 29 x 30" oak veneer plywood (side)
B	1	3/4 x 24 x 27 1/8" particleboard
C	1	3/4 x 24 x 30" particleboard (top)
D	1	3/4 x 24 x 29 5/8" particleboard (bottom)
E	1	3/4 x 24 x 24" oak veneer plywood (kick)
F	2	3/4 x 1 1/8 x 28 1/4" pine (shelf support)
G	1	3/4 x 23 x 29" oak veneer plywood (pull-out shelf)
UPPER DRAWER		
H	1	3/4 x 10 x 23" oak veneer plywood (front)
I	2	1/2 x 9 1/4 x 19" lauan mahogany plywood (side)
J	1	1/2 x 8 1/2 x 21 3/4" lauan mahogany plywood (back)
K	1	1/4 x 18 1/2 x 21 3/4" lauan mahogany plywood (bottom)
LOWER DRAWER		
L	1	3/4 x 12 7/8 x 23" lauan mahogany plywood (front)
M	2	1/2 x 8 1/4 x 19" lauan mahogany plywood (side)
N	1	1/2 x 8 x 21 3/4" lauan mahogany plywood (back)
O	1	1/4 x 18 1/2 x 21 3/4" lauan mahogany plywood (bottom)
P	4	3/4 x 3 1/2 x 3 1/2" plywood (mounting block)
Q		1 1/8" oak veneer
R		1/8 x 24 x 30" plastic laminate*
S	2	pr. 18" full extension drawer slide
T	3	Brass drawer pull
U	4	Caster
V	2	3/4" No. 8 rh screw (adjusting screw)

Misc: Carpenter's glue, linseed oil, paste wax, contact cement.
*Formica brand plastic laminate, Tidal Sand No. 917.

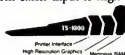


NOTES:
1—3/8 x 3/4" DADO
2—3/8 x 3/4" RABBET
3—3/8 x 13/16" DADO



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If you own a TS-1000 or ZX-81 computer and want to bring out the power within it, you'll want Memotech. From easier input to high quality output and greater memory, Memotech makes the add-ons you demand. Every Memotech peripheral comes in a black anodized aluminum case and is designed to fit together in "piggy back" fashion enabling you to continue to add on and still keep an integrated system look.



MEMOPAK RAM All Memopak RAMs are directly addressable, user transparent, are neither switched nor paged and no additional power supply is required. You can also choose the Memopak RAM which is just right for your needs. From economy to power. **16K RAM** The Memopak 16K RAM is the most economical way to add memory to your TS-1000. It is fully compatible with the Timex or Memotech 16K RAMs to provide you with up to 32K of RAM. The 16K RAM also offers additional add-on capabilities through its "piggy back" connection. **32K RAM** The 32K Memopak enables you to execute sophisticated programs and store large data bases and like the 16K RAM is fully compatible with Timex's or Memotech's 16K RAMs to give you a full 48K of RAM. **64K RAM** The 64K Memopak is powerful enough to turn your TS-1000 into a computer with capabilities suitable for business and educational use. It accepts such BASIC commands as 10 DIM A (9000). **MEMOCALC** Memocalc, our spreadsheet analysis

software, enables TS-1000 users to perform complex number crunching routines with ease. With the 64K RAM a table of up to 7000 numbers with up to 250 rows or 99 columns can be specified. Quick revisions can be achieved by entering new data to your formula.

MEMOTECH KEYBOARD For ease of operation, the Memotech keyboard is a high quality standard typewriter keyboard, with TS-1000 legends. The keyboard is cable connected to a buffered interface which is housed in a standard Memopak case and plugs directly into the back of the



TS-1000 or other Memopaks. **MEMOPAK HRG** The Memopak High Resolution Graphics, with up to 192 by 248 pixel resolution, enables display of high resolution "arcade game" style graphics through its resident 2K EPROM, programmed with a full range of graphics subroutines.

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Memotech's Interfaces enable your TS-1000 to use a wide range of compatible printers. The resident software in the units gives the



complete ASCII set of characters. Both Memopak Interfaces provide lower case character capabilities and up to 80 column printing. The RS232 Interface is also compatible with modems and terminals.

SEIKOSHA GP 100A PRINTER The Seikosha GP 100A uses a 5x7 dot matrix printing format with ASCII standard upper and lower case character set. Printing speed is 30 characters/second with a maximum width of 80 characters. The printer uses standard fanfold paper up to 9-1/2 inches wide. The GP 100A is offered as a package including cable and



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GP 100A Printer Package**	399.00		
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TOTAL			\$
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COMPUTER SOFTWARE

Programs Solve 'What If's'

Ever since *Visicalc*, computers have offered users the power to juggle their finances. Latest programs in this category are better than ever.

Will a new heating system for your home really pay for itself in two years? Is it practical to make major repairs to your car or should you trade it in for a new model? Will new machinery for your business increase profits? How much will your savings be worth when you retire?

Solving "What if . . ." problems is precisely the kind of thing computers do best. Plug in the right numbers to the right kind of program and the computer will run forever, if necessary, printing

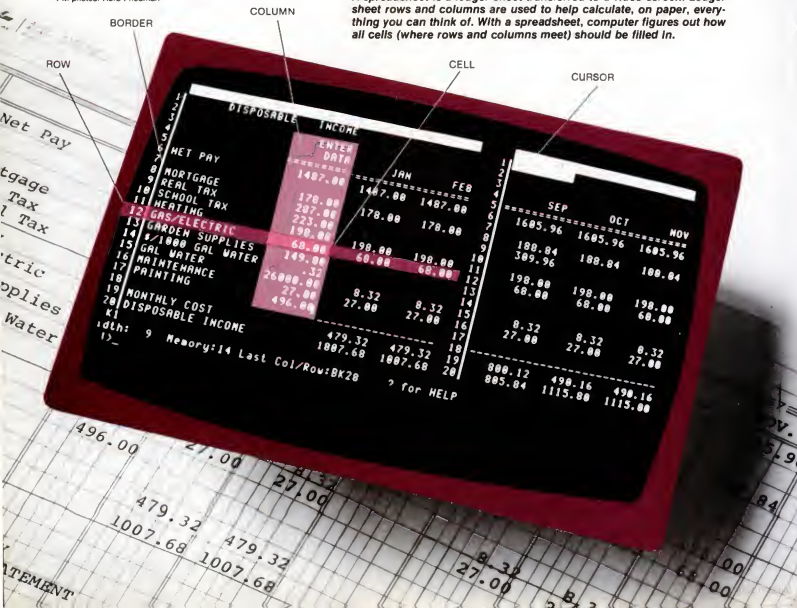
out every conceivable answer to your questions. It will give you 10, 20, 30 or more hypothetical answers to "What if . . ." in even less time than it would take you to write the problem down on paper.

The computer software that answers your "What if . . ." questions is called an *electronic spreadsheet*, and is best known under such names as *Visicalc*, *MultiPlan*, *Supercalc*, *Target*, *VU-Calc*, and innumerable other variations of " . . . Calc."

Visicalc, *Supercalc*, and the other *Calc* programs are electronic representations of the accountant's spreadsheet, a large paper on which a pattern of rows and columns form a grid of boxes called cells. On a spreadsheet, the accountant calculates the cash flow of a family, business, or whatever he is working on. The data in a cell, whether a value or a mathematical formula, can be made dependent on the data in other cells. A variation in the data of just one cell can ripple through many others. So,

PM photos: Herb Friedman

A spreadsheet is a ledger sheet transferred to a video screen. Ledger sheet rows and columns are used to help calculate, on paper, everything you can think of. With a spreadsheet, computer figures out how all cells (where rows and columns meet) should be filled in.



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as you might imagine, it takes a lot of erasing and recalculation of values each time the information in a single cell is changed.

The format of the electronic spreadsheet closely resembles the paper version. There are labeled rows and labeled columns, and the intersections of the rows and columns create cells. Formulas, values and even titles are entered into the cells through the keyboard. But unlike the paper spreadsheet that requires much erasing to plot the effect of changing the data in a cell, the electronic spreadsheet can recalculate all the affected cells almost instantly. The user can actually see the changes ripple through the cells row by row and column by column.

Video worksheets

The "sheet" of cells filled with titles, values and formulas is called a *worksheet*. As a general rule, the size of the worksheet is much greater than what can be shown on a video screen, so the screen functions as a window that can be positioned on any part of the worksheet. Depending on the specific type of Calc program, it's possible to combine widely different areas of a worksheet on the video screen, create a video display that combines sections from other worksheets, and even get a printout of combined worksheets.

If you don't care to prepare your own worksheets, you can obtain prewritten worksheets on a floppy disk. These worksheets are called templates and are available from several sources for both home and business applications. The templates contain all the needed formulas to manipulate your own set of figures. They can save you many hours of work.

There is some form of Calc software which will run on just about every computer. The precise features, such as the size of the worksheet, the mathematical operators and the on-screen prompts, depend on the particular computer, the available computer memory and, of course, the software. Surprisingly, features or convenience of operation have nothing to do with price or anything else.

For example, the program *VU-Calc* for the Timex computer sells for less than \$20. It provides a worksheet of 26 rows by 36 columns (936 cells). It's not a large sheet by any means, but it will run in only 16K of RAM (Random Access Memory). It has a superb screen display that's particularly effective for beginners and, while it has only the simple mathematical operators of addition, subtraction, multiplication and

	A	B	C	D	E
1					
2					
3		100%	120%	150%	200%
4					
5	ENTER VALUE=>	1			
6					
7	ADD 2	3	3.6	4.5	6
8	ADD 2	5	6	7.5	10
9	ADD 2	7	8.4	10.5	14
10	ADD 2	9	10.8	13.5	18
11					
12					
13	TOTAL	24	28.8	36	48

	A	B	C	D	E
1					
2					
3		100%	120%	150%	200%
4					
5	ENTER VALUE=>				
6					
7	ADD 2	(B5+2)	(B7*1.2)	(B7*1.5)	(B7*2)
8	ADD 2	(B7+2)	(B8*1.2)	(B8*1.5)	(B8*2)
9	ADD 2	(B8+2)	(B9*1.2)	(B9*1.5)	(B9*2)
10	ADD 2	(B9+2)	(B10*1.2)	(B10*1.5)	(B10*2)
11					
12					
13	TOTAL SUM(B7:B10)	SUM(C7:C10)	SUM(D7:D10)	SUM(E7:E10)	

Above are actual printouts of a spreadsheet program (Supercalc). Top shows figures as they would normally appear. Bottom shows formulas resulting in figures.

How A Spreadsheet Works

The two figures above are printouts of what you would see on the video screen while running a simple spreadsheet. This particular worksheet will take any number you enter and add 2 to it four times in a row. It will then multiply the four new numbers by varying percentages and display the results.

Take a look at Figure 1. The number 1 has been entered to the right of the line which says ENTER VALUE=. The spreadsheet program then automatically calculates all the other numbers.

For instance, the program first added 2 to 1 and got 3, which it displayed in the 100% column. Then it showed that 120% of 3 is 3.6, and so on for the next two percentages.

Automatically adding to existing numbers and taking percentages of the result is just one example of the thousands of operations you can write a spreadsheet template or worksheet to do. While such things as amortizing loans and doing complex ledgers call for sophisticated program-

ming, it's all mainly a matter of practice.

Figure 2 shows some of the formulas that were devised to accomplish our sample task.

The entered value is typed in (as in Fig. 1) at the location where column B intersects Row 5. This is called cell B5. The first time the spreadsheet adds 2 to that value happens in column B, Row 7 or in cell B7.

The formula in cell B7 (again in Fig. 2) says B5+2. So, whatever value is in B5 will have 2 added to it and that new value will be displayed in B7.

So, if 1 (as shown) is typed into B5, the number 3 (as shown) appears in B7. But—and here is the real power of spreadsheets—if you typed 5 in B5, then 7 would appear in B7. Results change automatically as you enter new numbers.

So if you're doing a very complex budget, you can examine such things as what-if-the-rent-goes-up and see all the results right away. Spreadsheets make this kind of numbers management easy.

division, it has many of the cell functions of the more expensive, better known Calc programs.

Unfortunately, because *VU-Calc* is loaded into the computer from cassette tape, it's slow. It takes almost three minutes just to load the program, close to five minutes to load a saved version of a worksheet.

The most common forms of Calc software, such as *Visicalc* and *Supercalc*, provide a worksheet of nominally 63 columns by 255 rows, or more than 16,000 cells. They are intended to run in computers having from 32K/48K to 64K of RAM. In addition to larger work-

sheets, these spreadsheet programs provide advanced mathematic operators and routines such as auto-summation of selected columns and rows, automatic calculation of NPV (Net Present Value), exponentiation, and the transcendental functions such as sine, cosine and tangent. They also provide the relational operators of *equal* or *not equal* to, *less* than and *greater* than ("=" and ">"), and If... Then... Else.

There are, of course, many differences between spreadsheet programs, even when, on the surface, they appear to provide similar features. For example, while the cell-by-cell construction—



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SuperCalc from Sorcim (right) was one of the best Calc-style programs we looked at. Like MultiPlan and some other best bets, it enables the user to switch back and forth from the filled-in cells to programmed formulas.

Enter a Command

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3.0 REVENUE	1750000	2253750	2851562.5	3640006
4.0 RAW WATER	10000	11500	13225	15709
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6.0 PACKAGING	5000	5750	6612.5	8045
7.0 DISTRIBUTION	6000	9000	10500	12167
8.0 GROSS	1744500	2236250	2847111.1	3629987
9.0 DEBIT	40000	45000	47009	51092

LINE 1 UNITS SOLD=10000,57500,66125,76844

which was pioneered by Visicalc and later Supercalc—is the standard basic means of preparing a worksheet. Target PlannerCalc can be programmed rather than written cell by cell. Just typing the statement LINE 4 GROSS INCOME= 1000, 2000, 3000, 4000 will enter the title GROSS INCOME and all the pertinent information in the correct cells on row 4.

Window on the world

But rapid programming of data in cells isn't the only reason for the electronic spreadsheet's popularity. For many, the most important feature is the split window. The window is the small part of the spreadsheet seen by the video display. Splitting the window allows the user to compare results from different parts of the spreadsheet, or even parts or data from different spreadsheets. For example, a spreadsheet of a family's yearly net income month by month, used to determine when extra cash will be available—perhaps to purchase a washing machine or take a short vacation—can't fit on a screen because there are too many months for a screen display. It's simply too wide. But, it is possible to split the screen either vertically or horizontally so specific months can be compared side by side.

Until recently, Calc programs permitted one screen split—either horizontal or vertical. The latest versions of Calc software, such as MultiPlan, permit several splits, even bordered windows within the main window. MultiPlan permits up to eight such splits.

Choosing your Calc software

Calc software varies widely in price and features. Regardless of what you're willing to pay, it must run within your system and provide the operating features you need. The system limitation is RAM. There must be the minimum amount required by the software. But keep in mind that everything else is 100 percent expansion. That is, if the

spreadsheet program and the DOS (Disk Operating System) are running in 32K RAM, leaving only 4K available for your spreadsheet, increasing the system RAM to 64K provides a full additional 32K for data, not just another 4K.

Then, consider how often you will use the software. If you use it frequently, say daily, you can easily remember the operating codes and you will have no real need for on-screen prompts. But assume you use the program infrequently. Remembering 20 to 30 or more codes isn't that easy and on-screen prompts are a decided convenience. Although the on-screen prompts on the prompt line of Supercalc by Sorcim use only a single letter to represent a function or control code, they are easy to keep in mind because they are exactly the same prompts used by Sorcim's other software.

If prompts are hard for you to remember, or you use the software very infrequently, then the full-word menu-to-sub-menu on-screen prompts of something like MultiPlan might be what you need. All function prompts are always on-screen and in plain English. The user can either press a single letter key which represents the prompt, or move the cursor to the word describing the desired function.

Finally, consider if you plan to write a worksheet at all. It's a programming job that can take days, weeks or months to debug. There are many prewritten templates available. While some are for home and family use, most are for business. They include real estate management, engineering, even general payroll, including the printing of standard accounting forms.

Not every type of template is available for every Calc-type program. If you find a template that's suited to your particular use, you might want to buy the Calc program for which it was written. Remember, your own application is the most important consideration in purchasing Calc software.

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COMPUTER TELECOMMUNICATIONS

Communicating With Other Computers

Swap information, connect to vast networks or just chat. You can even fall in love. All you need is a computer and a modem.

Telecommunications is using a computer to communicate with other computers over normal telephone lines. You accomplish this with a device you add onto your personal computer—a modem. It may be a box which goes outside your computer or a circuit board which plugs inside.

When you type on your computer's keyboard, the modem converts the letters and numbers into digital tones. While the Morse Code uses dots and dashes, the computer ASCII (pronounced *askey*) code uses two different, almost musical, tones to encode your information.

After the modem is connected to your computer and phone line, check the services offered by large computer net-

works such as The Source and CompuServe. When you call one of these networks, via computer, you are calling a giant mainframe computer that may store thousands of databases full of information.

You just call a local number and computers along the way take care of routing your modem's tones through complex telephone byways to that central mainframe computer. The same network sends the larger computer's tones to you. In this way, your computer can have two-way contact with the large computer and, at the same time, hundreds of users can all be connected to that same large computer.

Once you are connected

to the mainframe computer, informational databases will be at your disposal. You will be able to do everything from reading news reports from The Associated Press to looking up airline schedules.

But still, you can buy a newspaper for 30 cents, so why use a computer? Well, besides the fact that you would have to buy hundreds of newspapers and magazines to equal the information stored in the computer, don't forget the *interactive* uses of telecommunications.

While connected to a database, you are seated in front of a full-fledged computer with a keyboard. It is a two-way connection. You can read what is coming across the screen, and then—in many instances—you can type back.

Computers communicate over phone lines by sending letters and numbers in ASCII code. Each character is sent as a nine-note combination of two tones. Any phone line may be used.



This is called *interactive video* and is the future of the computer networks.

Both The Source and Compuserve (the two largest computer networks) are beginning to tap the wellspring of interactive video. Both began their services by offering electronic mail (called EMAIL on Compuserve and SMAIL on The Source), which meant you were no longer at the mercy of the Postal Service if your addressee was also hooked into the computer revolution.

Quick and easy-to-learn areas allow you to type in a message to anyone else on the network. And, your message is delivered in a few moments, or a couple of hours at most.

SIGs, or Special Interest Groups, is an area that has been pioneered by Compuserve, although The Source is now offering a "Participate" program that is similar. In a SIG, a person leaves a message about that group's interest, or he replies to a string of messages. An original message, replies received and responses to replies

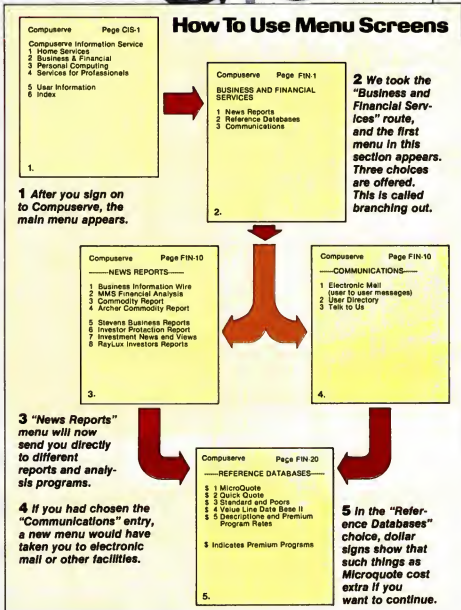
can be read in either sequential or logical order.

On Compuserve, the SIGs have proven to be popular and now cover almost every interest. There are popular SIGs for owners of the Heath, Apple, TRS-80 and Commodore computers; other SIGs about medicine or fire safety; some discuss how to write; and others show people how to sell their software ideas. Whether you want to exchange recipes or learn about going to the moon, there is a SIG for you.

And, both networks have extensive bulletin-board areas where you can buy or sell everything from software to a new home. In The Source's POST area or Compuserve's BULLET database, you'll find an electronic classified ad may solve your problems.

But the real power of the computer networks and of some of the bulletin-board programs discussed in *Join The Love Networks* (page 108) lies not so much in what they offer, but in the ability to reduce distances to nothing. Once

PM photos: Frank Lusk
Photos taken at Computer Center, New York, N.Y.



you learn to use their data storage and transfer areas, you're close to a concept known as the decentralized office.

Let's say that you have a long report to send to your company's offices throughout the country. The first thing to do would be to word process your report or other document. The document that you write is stored on a computer disk as a file. This file contains the document in the form of the ASCII code.

You must then take advantage of a process called uploading. Uploading a file means that you use your own computer to send the document now stored as a file on a disk to another computer. In this case, you telephone a local number and send the file to the private storage area you have available on the network's main-frame computer. This uploading process is usually controlled by a terminal program which you've bought for your computer. (Such programs include *ASCII EXPRESS—THE PROFESSIONAL* for both Apple and IBM, *DATA CAPTURE 4.0* for the Apple and *PTALK* for the IBM, among others.)

Once you have uploaded your file all the offices you want to share that information with must go through the reverse process, called downloading. A printer turns the files back into documents. After reading the material, the office managers frame their replies and upload their final responses.

Vanquishing distance may prove to be the computer's greatest asset. **PM**



Modems come in various shapes and sizes. Tymshare's Scanset terminal (top) includes both a modem and display with a full keyboard. Hayes Smartmodem 1200 (middle) connects any computer to a phone line. Universal Data System's 212A/D puts a full menu of commands on the connecting computer's screen.



A computer network may be made up of hundreds of small computers all calling a giant, mainframe computer system. Or, it can be something, well, more intimate.

Many computers will operate as electronic bulletin boards when equipped with the right software. A bulletin-board computer accepts phone calls from other computers (any computer with a modem will do) and allows the person with the calling computer to leave, or post, a message. The caller may also read any of the messages previously posted and may respond to them.

There are now thousands of these bulletin-board computers throughout the country. They're run from living rooms, computer stores, colleges and even hospitals. The people running them all have one thing in common: They are shaping, today, the methods that other people will use to communicate tomorrow.

The bulletin boards cover all interests, from computer adventure games to high-level discourses on surgical procedures. If you become involved in these bulletin-board systems, you may find your monthly phone bill taking off like a rocket.

Because they are not large networks, you must pay for a long-distance call to any computer system beyond your free calling area. Although there are bulletin boards in every state, you are bound to find a couple you love that are 2,000 miles away.

The latest trend in these electronic ser-

vices is what we term "the love network." Here, believe it or not, you may find the mate of your dreams only a short ASCII code away.

Callers to a dial-your-match system are first given a secret password. Then they are asked to fill out a short questionnaire. The questions ask such things as height and weight, and may also get into astrological signs and sexual preferences. Nothing too forward—most of the questions might be asked at a typical office party. Then the fun begins. The caller's questionnaire is computer matched with all the others and a list of likely matches is printed on the screen. The caller can then read the answers given by those the computer has picked as compatible. If all looks good, a correspondence can begin.

According to Gregg Collins of Matchmaker Enterprises, the idea has really taken root. Everything from casual dating to marriage has resulted between people who have met via computer. So, if you're ready for it, on the other side of your modem, people like Lynn 432, Jill 490, Janet 418, Clark 201, Tony 765 and many more are just dying to meet you. And, who knows, if you really hit it off, maybe someday you'll even see each other!

So whether you want to play *Star Trek* or cupid—a modem is your ticket to the future.

Below is a list of some other computer systems to call (in order of area code).

Edison, N.J.	(201) 627-5151	Atlanta, Ga.	(404) 926-4318
Piscataway, N.J.	(201) 932-3887	Hayward, Calif.	(415) 538-3580
Cranford, N.J.	(201) 272-1874	Baton Rouge, La.	(504) 454-6888
Haledon, N.J.	(201) 790-6795	San Antonio, Tex.	(512) 340-6720
Danbury, Conn.	(203) 744-4644	Montreal, Canada	(514) 937-2188
Seattle, Wash. (Apple Crate I)	(206) 935-9119	Long Island, N.Y.	(516) 334-3134
Seattle, Wash. (Apple Crate II)	(206) 244-5438	Phoenix, Ariz.	(602) 996-9709
Staten Island, N.Y.	(212) 442-3874	Boston, Mass.	(617) 646-3610
New York, N.Y.	(212) 391-1664	Boston, Mass. (Pirates' Harbor)	(617) 738-5261
New York, N.Y. (McGraw-Hill)	(212) 897-2488	Hemdon, Va.	(703) 471-0610
Santa Monica, Calif.	(213) 829-1140	Annandale, Va. (IBM PCUG)	(703) 560-0979
Los Angeles, Calif. (Dial-Your-Match) #1	(213) 842-3322	Washington, D.C. (AMRAD)	(703) 734-1387
Los Angeles, Calif. (Games)	(213) 306-5535	Houston, Tex. (Madam Bokethea Society)	(713) 455-9502
Los Angeles, Calif. (Computer World)	(213) 859-0894	Freeport, Tex. (Gulfcoast)	(713) 233-7943
Los Angeles, Calif.	(213) 831-3574	Anaheim, Calif.	(714) 772-8668
Dallas, Tex. (Hacker-net)	(214) 824-7160	Burlington, Vt.	(802) 862-7023
Baltimore, Md.	(301) 764-1595	Newhall, Calif. (Computer Arts Message System)	(805) 255-6445
Greenbelt, Md. (NASA)	(301) 344-9156	Kansas City, Mo.	(816) 861-7040
Miami, Fla. (Big Apple)	(305) 848-8000	Memphis, Tenn. (Medical)	(901) 276-8196
Chicago, Ill. (Gamemaster)	(312) 475-4884	Missions, Kan. (Movie Guide)	(913) 432-5544
Chicago, Ill.	(312) 545-8088	El Paso, Tex.	(915) 755-1000
Arlington Heights, Ill.	(312) 870-7176		
Niles, Ill. (IBM-PC)	(312) 647-7636		
Greenfield, Ind.	(317) 326-4152		
Indianapolis, Ind.	(317) 787-5458		
Iowa City, Iowa (Apple-Med)	(319) 353-6426		
Cedar Rapids, Iowa	(319) 364-0811		

Hundreds of other phone numbers to call, as well as step-by-step examples on using a modem, are contained in *The Small Computer Connection*, by Neil L. Shapiro, published by Micro Text/McGraw-Hill, New York, N.Y.



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Horsepower	99 max.	82 max.	73 max.
Maximum Torque	119 lbs./ft.	101 lbs./ft.	107 lbs./ft.
Galvanized Steel	340 sq. ft.	265 sq. ft.	50 sq. ft.
Standard Payload	1,145 lbs.	1,000 lbs.	1,225 lbs.
Power Brakes/Load Sensing Sys.	Standard/Yes	Optional/No	Optional/No
Seats	Deluxe Buckets	Bench	Bench
Color-keyed Carpeting	Standard	Optional	Optional

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SNORKEL-TOW

(Continued from page 69)

added buoyancy and deck space, and a swiveling motor mount connected to a tiller handle allows you to steer the ring from inside.

Both craft were designed by Kent Markham of Jacksonville, Fla., a marine construction expert who also developed PM's popular series of Scuba-Tow diving scooters (see *Build PM's Exciting New Diving Scooter*, page 78, Sept. '81, and *Great New Gear For Underwater Fun*, page 72, Aug. '79).

The 12-volt trolling motor, made by Shakespeare, is easy to install because its housing is conveniently threaded to accept standard 1/2-in. plumbing pipe. A simple bolt-on mount is made from a 1/2-in. pipe flange and a short 1/2-in. nipple for a coupling.

By special arrangement with the manufacturer, PM readers will be able to purchase the motor by mail in stripped-down form—just the power head without the tiller shaft, mounting clamp and other hardware—thus saving you money (see ordering information at the end of the story). Total cost of the Snorkel-Tow rig, including motor, battery and materials, should come to less than \$150.

Building the Snorkel-Tow

Inner tubes are still used in truck and tractor tires and are readily available. Used tubes can be found at auto wrecking yards, or you can purchase a new one at auto supply outlets, farm-equipment dealers and national retail chains like Sears and Montgomery Ward. If you opt for a used tube, check for leaks before you buy.

For the Snorkel-Tow float, we chose a 10.00-20 semi-truck inner tube that, when inflated, has an outer diameter of 40 in. and an inner opening of 20 in. Size the plywood platform to suit the tube you use. Its rim should extend to the midpoint of the tube's cross section all around. In other words, for a 40-in. tube with a 10-in. cross section, the plywood disk should have a diameter of about 30 in.

The inner tube is lashed to the platform with six equally spaced straps running through slots in the disk's rim. The rope bridle is attached to the rim on either side so it forms a loop 6 to 8 ft. long.

Mount the motor as shown in the drawings, bolting it to the plywood disk so it falls on the fore-aft centerline, but is slightly ahead of the side-to-side centerline. Attach the pipe flange and nipple to the motor housing as tightly as possible before marking the plywood for the bolt holes. The motor should not be free to swivel once it's attached. Before making the final assembly, pack

auto-body filler or silicone sealant around the motor wires to seal out water.

For safety, it's essential that the battery be installed in a waterproof case to eliminate the danger of electrical shocks. Such molded-plastic cases are made especially for marine use and are available at marine supply outlets or through Sears. We selected a Sears model that sells for about \$8 (catalog No. 6AV58159).

To control the motor, it's necessary to install a switch inside the battery case so its terminals are safely shielded. We used an ordinary knife switch, but mod-

ified it slightly as shown. The metal switch parts are removed from the original bakelite base and mounted instead on a small wood block, using long bolts that extend through the block to serve as terminal posts for connecting the wires. The block is then bolted to the underside of the battery-case lid. The switch handle protrudes through a slot in the lid so that only the handle is exposed.

Follow the wiring diagram for making connections. The motor comes prewired with leads long enough to reach up to the battery case without having to make any splices. Bare the ends, wrap



them around the battery's terminals and secure them in place with hose clamps. The hot or plus lead is broken at the switch, leaving the ground connection always intact. Cover the wires with rubber or plastic tubing.

Caution: Under no circumstances should you attempt to operate the Snorkel-Tow without a protective battery case. It is an absolute must, especially since the raft is likely to appeal to children. This also applies to the two-man, sit-in version.

If you use a home charger to recharge the battery yourself, be sure to do it in a well-ventilated area, preferably outdoors or in an open garage.

During the charging process, lead-acid batteries give off hydrogen gas that can be explosive if ignited by a spark. Don't smoke in the area or handle any equipment that might cause a spark.

Another must for safety is a bright-colored diver's flag. A snorkeler in the water is not readily visible to passing boats and the raft itself, being low and black, is hard to spot. Such flags are available at dive shops and other marine outlets. The drawings show how to make a removable flag mast to facilitate storing the craft.

The two-man, sit-in raft is merely an

enlarged version of the Snorkel-Tow float, fitted with a tiller handle for steering. We used a 13.6/12-38 tractor inner tube from Sears (catalog No. T95AF15008C), which sells for about \$34. It has an outer diameter of about 60 in. and an inner opening of 38 in., providing plenty of seating space for two adults.

Unlike the fixed motor on the Snorkel-Tow, the motor on the raft must be free to swivel so you can turn it with the tiller. This is done by making the 1/2-in. pipe nipple a tight fit in the motor housing, but a loose fit in the mounting flange so the motor will rotate on the threaded connection.

In addition, a second, 3/4-in. pipe nipple is inserted in the 1/2-in. nipple so it projects above the plywood floor, providing a post to which the tiller handle can be attached (see drawing detail). You can fasten the 3/4-in. nipple in the 1/2-in. nipple in either of two ways. You can grind off the threads on the smaller nipple and weld the two together, or you can have the inside of the larger nipple threaded to take 3/4-in. pipe and screw the two together.

The tiller handle is made of 3/4-in. electrical conduit, which must be bent to a curve on a tubing bender at a metalworking shop. If you prefer, you can avoid the bending operation by using two short lengths of conduit joined together with a right-angle connector to form an L-shaped handle. In either case, split the lower end of the conduit four ways with a hacksaw so it can be forced over the 3/4-in. pipe nipple and secure it with a hose clamp as shown.

When you turn the tiller, the motor pivots in its mount, propelling you in the direction you want to go. You can even reverse direction by swinging the tiller until the motor points backward. The motor wires run up through the handle and out a hole in the side to the battery case. Protect the wires with rubber or plastic tubing and leave enough slack so the tiller can be turned without straining the connections.

Two-motor version

If you're looking for a bit more speed and maneuverability, you might want to consider PM's deluxe twin-engine model. In this case, two identical 12-volt motors are mounted on the ends of a steering arm so they pivot together when the tiller is turned. The mounting arrangement is basically the same as for the single-motor installation, except that the steering arm is attached to the 1/2-in. pipe nipple with a second flange so it swivels. The motors are bolted to the arm with their own flanges.

The motors are available from Kent Corp., 4818 Evenlode La., Jacksonville, Fla. 32217. The price for each is \$82.50 postpaid.

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DETROIT CONVERTIBLES

(Continued from page 61)

coups. When you take the top off such a car, the resulting structure needs reinforcement to prevent general loosey-gooseyness, and that means adding strength without adding tremendous amounts of weight.

Typical methods

Chrysler's methods are typical. Chrysler adds gussets and strengthening members to the toeboards, central tunnel, rear bulkheads and the torque boxes over the rear-wheel arches. In addition, beams run up both A-pillars; across the windshield header bar, along the door tops, behind the lock pillars and behind the rear seat.

MoPar convertibles get special side windows, with reworked bump stops that tilt the upper edges of the glass inward for a tighter seal. Shoulder-harness attachments often have to be beefed or relocated in these convertibles.

The hydraulic top motor/reservoir goes behind the rear seat with all its attendant plumbing and wiring.

Each convertible conversion presents its own set of special requirements, of course, and some cars need braces and brackets even beyond those mentioned. Most convertibles also get more sound and temperature insulation than their coupe counterparts.

What's still to come

There's no question that we'll be seeing more convertibles in the future. Cadillac plans to introduce an Eldorado ragtop for the 1984 model year, which will also be converted by American Sunroof and mechanically will be the same as the Riviera.

Chrysler hopes to bring out its Mercedes-like 2-seater for 1985, with at least one soft-top rendition.

And Ford has delved into the possibility of launching an Escort/Lynx/EXP/LNX convertible. The Escort, which has been mocked up, would look and be a lot like the VW Rabbit ragtop, presumably with a full rollbar.

Another possible Ford conversion centers on the new Thunderbird/Cougar coupe. It seems a natural. But so far, Ford's not commenting.

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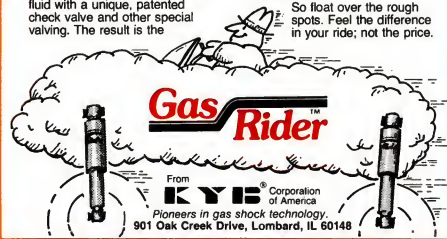
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GARDEN SHED

(Continued from page 82)

tools you need are a long straightedge and rule plus a 45°/90° triangle.

For best results, mark and cut the first two panels from the back. Sawing with the good face up will cause splintering along the cut line. Label each part as indicated in the plan. Then, using one set of parts as templates, lay them face down on the face of the third panel and trace the outlines. Since you will cut the third panel face up, use a hollow ground blade to reduce splinter-

sections of panel that meet with a butt rather than in a lap joint, or at seams formed by warped panels. This seals the seam. Also install gussets (F).

The door frame (N and N1) is assembled with half-lap joints. Use waterproof resorcinol or water resistant plastic resin glue on the joints. Glue also is used with nails to attach the door panels to the frame. Glue isn't needed on the other assemblies.

Hang the door with tee hinges (M). To keep the door from sagging, attach hinges to the jamb. Then shim the door in place with the desired (3/16 in.) clearance on all sides. Install the latch (R).

At this point, you can install the planter box. Secure cleats (A and A1) for the top edge of the siding to the bottom of the planter. Attach the planter by driving nails from the top through the bottom of the planter and directly into the ends of the vertical 2x4s. Nail the top of the panels to the nailing strips.

Install the shelves (W) with supports (U) and edging (V). After driving nails to hang hand tools into the tool-hanging strips (G), nail the strips in place. Finally, paint or stain the shed. We used Olympic Acrylic Latex Solid Color Stain in two colors: chamois and cedar. **PM**



Drain tubes inserted in holes bored in the rear of planter direct water away from the shed to eliminate water stains.



Inside view shows shelves, battens over butt joints and the tool-hanging strips.

ing, or use a handsaw. This will give you the one set of reversed sections.

After the pieces have been cut, tack-nail the back parts to the frame. Then trace along the edge of the 2x4s to mark the excess for trimming. Permanently attach the back panels. Repeat the procedure for the side panels. The tops of the side panels are nailed to cleats (A and A1) after the planter is in position.

Battens (L) are required behind those

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- Protects metal against

CATHEDRAL

(Continued from page 55)

creased to eight stonecutters and four machine-shop workers.

The fact that most of the present crew, all in their mid-20s to mid-30s, had no experience in masonry, much less in stonecutting, didn't bother Bambridge. "I don't worry about experience," he said. "I look for character, integrity and desire to learn." If you wander through the dusty stoneyard today, busy apprentices will quit swinging their four-pound mallets long enough to confirm, over the din of diamond-studded saws and clanking chisels, that the Bambridge hiring system works. Present stoneyard crew members come from varied backgrounds. The group includes a couple of former East Harlem gang members, a former air conditioner repairman, a former bookstore sales clerk and a teacher.

At the start, machinery had to be found to handle the giant blocks that soon would arrive on 40,000-pound flatbeds from the same Indiana Limestone Co. quarry that supplied the original stone for the cathedral. "It's also the quarry that produced stone for the Empire State Building," Bambridge said.

Walking through the stoneyard today, Bambridge and Bird point with pride to the clanking, whining machines that supply 20th-century time and money-saving technology to supplement the medieval crafts. The 67-year-old giant planer that removes excess stone from complex pieces was a rusty hulk with bushes and weeds—including poison ivy, Bambridge discovered later—growing through it. It had been lying beside an abandoned railroad track at the quarry for years. The big circular 60-inch saw was found in a nearby pasture.

"Such machines are hard to find anywhere today," Bambridge said, "so we salvaged them, had them steam cleaned and rebuilt with parts cannibalized from similar old wrecks we found here and there." The only new item is the 8-foot, diamond-toothed reciprocating saw that slices the huge quarry blocks. It was made to Bambridge's specifications in Scotland.

Sliced like bread

How these devices fit in the scheme of things becomes clear when a big, 20-ton flatbed trailer wheels into the stoneyard from Indiana. On its back are two 8- to 10-ton blocks, measuring about 4 by 4 by 12 feet. In seconds, the overhead crane is in position. Someone runs the heavy wire slings under the first block and secures them to the crane hood. The great block is lifted and moved slowly to a tracked dolly

under the reciprocating saw, like a yacht being raised from the water to its yard cradle for winter. The long, diamond-toothed blade rocks back and forth across the stone, cooled by water pouring through the kerf, and the block is sliced like a loaf of bread.

As each slab is freed, one every three or four hours, it is moved to the nearby circular saw, where it is cut by whirling diamonds to rough building-block specs. If it's to be a molded column base or section, it goes ahead to the planer, where it rides a platform that carries it under specially forged blades which peel away excess stone between the high contours. They remove a quarter of an inch per five-second run.

Once the big machines have thumped, whined and ground their way through live stone, the rough blocks are ready for facing and shaping under the stonecutters' tools. These include everything from the wide boaster to oddly shaped devices with names like waster, punch, cockscomb, quirk and point. There are some 60 weird tools, many handed down from the Middle Ages through generations of stonemasons.

Tools are hard to find

Most such tools of proper quality are difficult to find today. Bird brought his own with him from Wells. Copies for the apprentices had to be specially forged, and the master mason spent many early days showing the novices how to fashion their own mallets from seasoned hardwoods. The beginning stonecutters then progress from dressing the single face on standard rectangular building blocks, called ashlar, to the two- or more-faced corner blocks, or quoins. From there, they move on to more complicated forms such as bases or sills.

What happens when someone goofs and ruins a stone? "It never happens, except sometimes," said Bird, wincing. "We call it a poked stone. With luck, we can let it in a piece. If not, it's set aside until we need a smaller piece that can be cut from it."

The stones, Bambridge said, are cut to millimeter accuracy, just like medieval stonework. The towers could be put up dry. Mortar is used to take up minute discrepancies in the stone, and to keep out the weather. "But the yardstick used is to design and cut so that it would stay up there on its own with no mortar," Bambridge said.

Ordinarily, a specialist working under Bambridge would do the setting-out—turning out half-inch scale working drawings from the architect's one-eighth scale rendering. He'd also produce the full-scale "base molds," or templates, in zinc. These cross sections of complicated stone units, such as colonnetted columns, are laid out on a

spacious floor, like a full-scale lofting floor in a boat yard. In addition, the specialist would specify joints for the stonemasons, produce a job ticket on each stone to be cut and take care of production schedules. But since only Bambridge was in on the original planning and timetable decisions, he does both planning and directing.

In his office apartment on the cathedral grounds, Bambridge unrolled a working drawing of the north tower. It shows every stone in the face. In the center of each is a circled number. "Each stone has its own number," he explained, "and each has a card in my file describing it and its position, in code. N means it's the north tower. D means it's the fourth section up. The fraction numbers are its dimensions. The other number is its cubic volume. At year's end, I tote up how much foot-cubage we've produced, check it against the foot-cubage the quarry has delivered, and arrive at my waste factor—an important factor in cost control."

Each card becomes a job ticket that goes to the stoneyard. When a stone is produced from it, the master mason takes a yellow crayon pencil and colors that numbered stone in his copy of the working drawing. "It's right there in

front of him on his yard office wall," said Bambridge. "No way can he repeat that job."

In a modern masonry building, Bambridge pointed out, once the second floor is designed, the same pattern repeats for the next 20 floors. Here, each stone is an individual piece to fit a given space. "In the 12th century, they'd work the stone as it came from the quarry," he said. "The stone was cut to whatever it would make." To keep faith with that medieval system, Bambridge deliberately throws in an off-length ashlar or quoin every here and there, "so that when someone looks up at the building, it's not going bump-bump-bump all the way up. It moves around as if it had been done in the old Gothic style."

Dean Morton likes to point out that the use of such 700-year-old techniques is what separates the work at St. John from other contemporary cathedral-building projects, such as the National Cathedral in Washington, D.C. "Their ashlar are all cut and finished to standard sizes at the quarry," he said. "They're delivered to the site ready to lay up like bricks." The dean enjoys referring to such building projects as "off-the-shelf cathedrals."

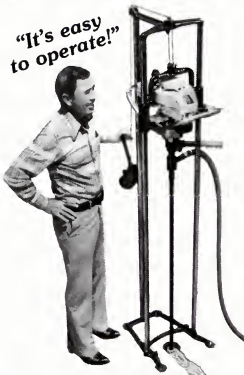
Originally, the plan at St. John called

for enough stone to be cut to complete one tower before any stone was laid up. Instead, some of the stonemasons were trained as masons and began erecting the north tower last year, much the same way their counterparts would have done it in the Middle Ages. Each finished stone is trundled by hand aboard a small personal hoist, lifted to its scaffold platform level and manhandled into its designated position.

Many new plans are afoot at the cathedral. Up in his oak-beamed office, Dean Morton can show you studies for a possible huge solar greenhouse that would sit above the Gothic vaulting atop the finished south transept, which would, itself, be wrapped in steel-framed glass. Not only would it provide warmth for the vast nave in winter, to help slash the great cathedral's million dollar annual fuel bill, but it also would create a spectacular year-round arboretum.

"The decision to begin building again now is a sign of hope for the whole city, a factor bringing new spirit to our local community," said Dean Morton. The stoneyard is only, as he put it, "a single chord, though a major one, in a symphony of arts and crafts at the still-building, century-old Cathedral of St. John the Divine." **PM**

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LIGHTNING

(Continued from page 57)

moves up above ground, it will find negative ions to draw it up in steps. Meanwhile, the negative particles are flowing down from the cloud. Eventually, the shower of electrons and the waves of positive charge meet in the air and a lightning bolt is ignited.

The process takes place in millionths of a second and the amount of energy released is tremendous. The potential between cloud and ground is an average 10 million to 50 million volts. When the first spark of lightning forms, it creates a step leader, a mini lightning bolt that reaches farther down the path of least resistance to charge up an ensuing step leader. As the lightning rips down what amounts to a charge chute—a veritable funnel of particles that creates a field to carry the bolt—air molecules are heated up and torn asunder. The combination produces the light and thunder of lightning.

The traditional lightning rod rises out of the corners of the roof of a building, drawing negative ions down to ground. Thus, lightning rods theoretically provide a channel for the positive wave to meet the negative shower. Instead of lightning hitting the roof, the Franklin theory states, the bolt is channeled safely to ground by the pointed rod. Unfortunately, many buildings "protected" by lightning rods still have been hit and damaged.

"I've had six rods on top of a mountain at Langmuir and in 20 years I've had no evidence that they've been hit," Moore says. "These are good, sharp stainless steel rods." Even so, he says, lightning has hit trees and low-lying structures close to the rods. Socorro, N.M., where the Langmuir labs are located, has the second-highest frequency of lightning strikes in the United States. The first is Orlando, Fla.

Saint Elmo's fire

Langmuir researchers believe the lightning rods haven't worked because of the buildup of a coronal discharge around the rod's point. The discharge, known as Saint Elmo's fire, is a blue-green glow of charged particles that draws off oppositely charged particles from the air. As it does, the positive wave beneath the rod shifts away from it, seeking a less disruptive path. Thus, it seems, the pointed rod merely shifts the path of a lightning bolt slightly.

For Moore, the answer to this problem was to go with blunt-tipped rods or arrays of wire, or a combination of the two. "Elevated blunt rods or horizontal conductors suitably grounded to earth can provide better lightning paths than the pointed rods," Moore says. The blunt rods build up a coronal discharge

at a far slower pace. The difference is in terms of thousandths of a second. Since lightning bolts take millionths of a second, the difference may be crucial.

Another prominent name in the lightning field, Roy B. Carpenter Jr., agrees with Moore on the inadequacy of the Franklin-type lightning rod. But Carpenter, whose Lightning Elimination Associates makes the revolutionary Dissipation Array, feels the problem lies more with overall systems design than with the shape of the rod itself. Carpenter's patented lightning arrays, marketed since the 1970s, use hundreds, even thousands, of pointed rods spread over a wide area and elevated above the roof of a protected structure. This umbrella of lightning rods, while not the most beautiful sight, is beloved by those who have come to rely on it.

No strikes since '78

"We haven't had a lightning strike since 1978," says Al Fuchs, manager of KQTZ-FM, a radio station in Hobart, Okla. "We built our transmitter on a mountain site abandoned by the highway patrol. They had used it for a communications station, but it kept getting knocked out by lightning." Fuchs says the Dissipation Array has lived up to every promise—no lightning strikes on the protected building and no lightning around the roof or antenna.

The story is the same at Philadelphia Electric's Peachbottom atomic power plant in Pennsylvania's Susquehanna Valley. The plant has a Dissipation Array 725 feet over a gas stack used to let out nonradioactive steam.

"We were at our wit's end when we installed the Dissipation Array four years ago," says Bill Van Buskirk, a Philadelphia Electric engineer. "We had standard lightning rods protecting the area, but we kept losing electronic sensing equipment when lightning struck it." Since the cone-shaped array was erected above the gas stack, the plant hasn't had any strikes. "We've had a few ground surges [a buildup of the positive particles], but they haven't done any damage," says Van Buskirk.

"Current codes for lightning protection are archaic," Carpenter says. "They don't take into account the wide area of exposure for most structures. Using a traditional lightning rod on a building is like emptying the Grand Cooley Dam through a 1-inch pipe."

Lightning won't build up

At the absolute worst, Carpenter says, the array system he's developed will draw off a little Saint Elmo's fire. But it won't allow lightning to build up around the structure it protects. The typical Dissipation Array is an umbrella on a high tower. The umbrella section throws a shadow of protection over the

building. All along the top of the umbrella are pointed lightning rods that run down to ground alongside or through the building.

The rods aren't meant to draw lightning, but rather to draw away negative charge. Since they are spread over the entire area of the building's roof, they guard against the problem raised by New Mexico Tech's Moore. If the field moves away from one rod, it runs into another just inches away. "The traditional lightning rods are built with the assumption that you can dump millions of volts into mother Earth. But it just isn't so," Carpenter explains.

To date, Dissipation Arrays have been erected over oil wells, radio stations, communication towers, factory buildings and only a few private homes. Carpenter says it was a matter of marketing concentration that kept him from the homeowner's market.

This year, Lightning Elimination Associates introduced a kit that a handy homeowner or a lightning installation company could use to protect a private home. The kit costs \$2,500, a steep price for some homeowners, but cheap for those who live in areas where lightning poses a daily threat. While lightning Dissipation Arrays have proven themselves in the field when custom-built for big utilities and other companies, they haven't been tested on the mass-produced scale.

Searching for answers

Meanwhile, the search continues for an explanation of why a cloud turns into a literal dynamo in thunderstorm season. The Defense Department has been experimenting with a series of devices geared to draw charges away from an airplane in flight, hoping to figure out precisely how charges build up.

Using a network of radio dish antennas, researchers at New York's State University at Buffalo are studying the buildup of charges in a cloud system in hopes of explaining the phenomenon.

Is there any chance that lightning will one day be harnessed to produce energy? Most researchers laugh off the prospect as absurd, since the flow of juice involved would be on the order of an avalanche. Moore points out that Nicholas Tesla abandoned experiments earlier this century to find a way to harness lightning's power.

Carpenter agrees that the prospect of harnessing lightning is not realistic at this stage. But, he adds, "We may one day be able to use the charge bled off by protective devices to energize a bank of batteries. But that's pie in the sky right now. We're still demonstrating man's ability to eliminate lightning strikes. Once we've made our point, maybe then we can look ahead to harnessing lightning."

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(Continued from page 79)

Candy tray—Start by nailing a piece of 1/4-in. hardboard to a 3/4-in.-thick mahogany hardwood board. Then, cut out and edge-sand the candy tray's shape to both pieces simultaneously. Now, remove the hardboard and cut out the three tray sections. Sand the cut-out's interior edges smooth. Then, reattach the hardboard to the workpiece for use as a template.

Now, position one of the template's cutouts over the guide pin, start the router and make a plunge cut. Lock the carriage in this position, using the carriage lock knob. With the guide pin against the cutout's inside edge, slowly move the workpiece against the rotation of the cutter to groove the tray compartment's perimeter. Lower the carriage $\frac{1}{4}$ in. on each pass until you reach $\frac{3}{8}$ in. deep. Repeat this procedure for the two remaining tray compartments.

Once you've grooved all three compartments to $\frac{5}{8}$ in. deep, reset the depth of cut to $\frac{1}{4}$ in. Now, place one of the template's cutouts over the guide pin, make a plunge cut and lock the carriage.

Using a freehand movement, shift the workpiece back and forth to clear out the waste area. Continue, taking deeper cuts in $\frac{1}{8}$ -in. increments until reaching $\frac{5}{8}$ in. deep. Repeat this procedure for carving out the two remaining compartments.

Ease the candy tray's sharp outside corners with a 1/4-in. rounding-over bit.

Picture frame—The oval picture frame's decorative edge and rabbeted glass recess are both routed with ball-bearing piloted cutters. As is the case with all ball-bearing piloted routing, a template isn't required so the guide pin is removed.

After sawing the frame's oval shape, finish-sand the inside and the outside edges. Next, rout the decorative outside edge with a 1/2-in. beading cutter. Then, place the frame face down on the worktable and use a 3/4-in. rabbet cutter to route a 1/4-in.-deep rabbet in the frame's back, inside edge. **FM**

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Shopsmith Inc., 750 Center Drive, Vandalia, Ohio 45377 (Shopsmith overarm pin router, No. 505806, \$595).

PARAPLANE

(Continued from page 67)

then climbed to 500 feet and cut back the throttle to level off. At about half-throttle, the ParaPlane flies level.

"You're looking good," the radio in my ear said. "Try a few turns. Get the feel of how much foot movement it takes to make a turn."

I decided to turn right first, so I made a small forward movement with my foot against the right-turn lever.

Nothing happened.

Oh my God, it won't turn. How am I going to land a plane that won't turn?

Then I remembered something Snyder had said during my 15-minute pre-flight briefing: "The ParaPlane is purposely built to respond a bit sluggishly.



Belt-driven counter-rotating propellers provide thrust. Propellers spin on coaxial shafts. Plane's top speed is 26 mph.

It takes a lot of control movement before anything happens."

I pushed the lever further, and slowly, gently, the ParaPlane began to turn right. After several left and right turns, I became accustomed to the ParaPlane's response.

Actually, I was glad it worked this way. With the controls not being extremely sensitive to input, I didn't have to worry about getting myself in trouble with a slight foot movement. And if I really wanted to make a sharp turn, a long push on the lever resulted in a pretty quick turn.

One of the nice things about the ParaPlane is its simplicity. There are only three controls—throttle, right-turn lever and left-turn lever. Your feet rest on the turn levers. And your left hand operates the throttle.

Full throttle results in a slow climb,

(Please turn to page 121)

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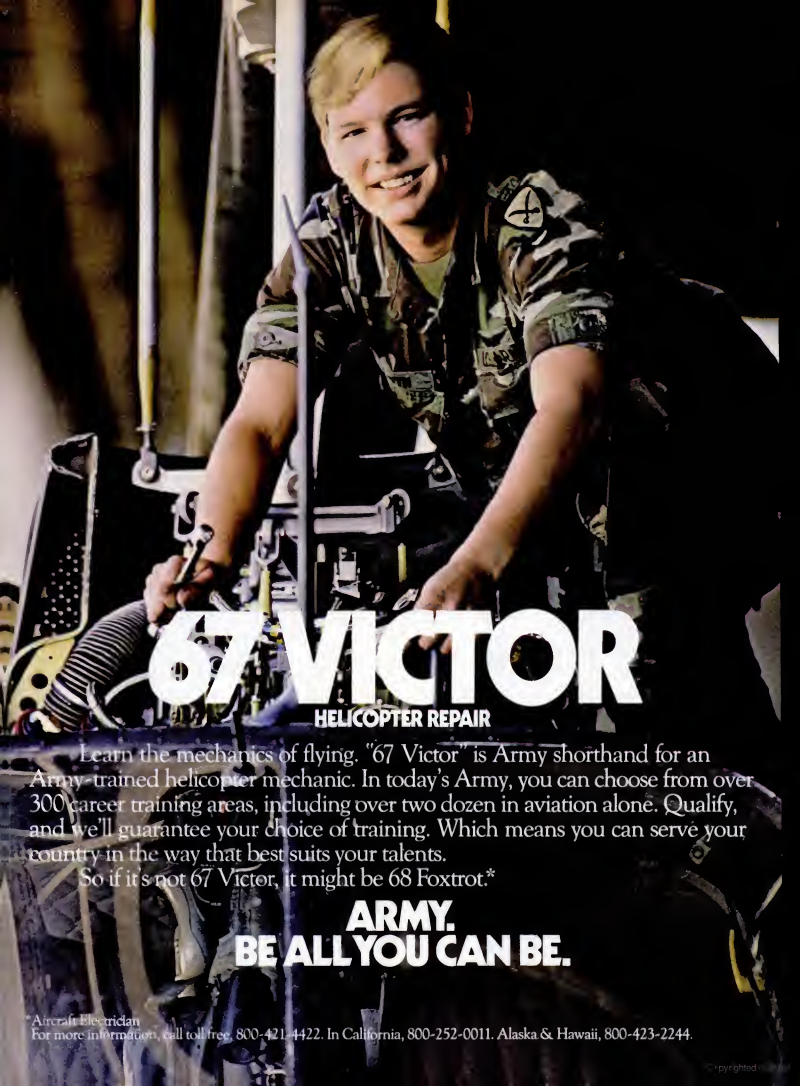
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PM'S PICKS FOR PICNICS

(Continued from page 73)

sure to avoid rounding the inside center portion of the lower end rails where the stretchers join. Don't round the edges of the legs past the points where the rails will join. Rounding-over cuts at the ends of stretchers can be stopped with a simple jig like the one shown in the photos on page 132. When this stage of

(Please turn to page 128)



Apply thin coats of waterproof glue to both surfaces of joint. Heavy coats will result in messy squeeze-out.



Dry-assemble the table with bar clamps and bore pilot holes for the lagscrews into the side rails and stretcher.

MATERIALS LIST— DESIGNER PATIO TABLE

Key	No.	Size and description (use)
A	2	1 1/2 x 4 x 36" ash (inner end rail)
B	4	1 1/2 x 4 x 28 1/2" ash (leg)
C	2	1 1/2 x 4 x 36" ash (lower end rail)
D	2	1 1/2 x 4 x 57 3/4" ash (inner side rail)
E	2	1 1/2 x 2 1/2 x 57 3/4" ash (ledger strip)
F	2	1 1/2 x 4 x 57 3/4" ash (stretcher)
G	2	1 1/2 x 1 1/2 x 4" ash (block)
H	1	1 1/2" i.d. x 3/4" PVC pipe (sleeve)
I	2	1 1/2 x 4 1/2 x 37" ash (outer end rail)
J	9	1 1/2 x 4 1/2 x 34 3/4" ash (slat)
K	2	1 1/2 x 4 1/2 x 34 3/4" ash (end slat)
L	2	1 1/2 x 4 1/2 x 62 1/4" ash (outer side rail)
M	8	5/8 x 3" lagscrew with washer
N	16	3" No. 14 ft screw
O	48	2" No. 14 ft screw
P	8	1 3/4" No. 14 ft screw
Q	1	4" (20d) galvanized common nail (post lock)
R	72	1/2" dia. x 3/4" walnut plugs
S	1	54 x 60" fabric (tablecloth)
Misc.		3/4" galvanized brads, resorcinol glue.

TECHNOLOGY UPDATE

MILITARY

License needed to play *WarGames*

A teen-age computer buff accidentally gains access to the Defense Department's supercomputer on his personal console. Within moments, he's matching wits with the single computer responsible for all the nuclear missiles under the North American Air Defense (NORAD) command. And it quickly escalates to the brink of war with Russia.

This improbable plot is overcome by the quick pace and dazzling high-technology sets of *WarGames*, the MGM/United Artists film. In particular, Angelo Graham's design of the NORAD computer room stands out as a bright haven of accuracy. Defense Department spokesman William Hutchins says the celluloid NORAD computer center looks a lot like the real thing. The film makers had help from retired Air Force TV liaison Duncan Wilmore and a half dozen Defense Department contractors who supplied the equipment to generate graphics. The graphics show everything from the location of an advancing Soviet submarine force to the readiness of U.S. missiles.

But among the film's unbelievable points was the control that a single computer had over all U.S. missiles. After all, a single Space Shuttle uses one main and three backup computers. The Defense Department won't say how many computers run the real NORAD.



A young computer buff uses his modest equipment to break into the memory banks of NORAD's supercomputer in *WarGames*, a high-technology movie.

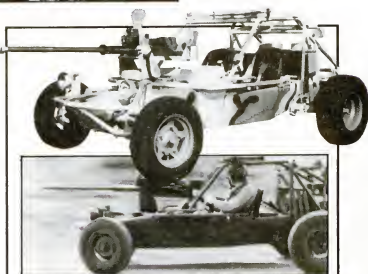
But can you cook?

The heralded steel pot worn by GIs since World War II is going the way of the jeep—out. Next year, the Army will begin replacing the steel helmets and their plastic liner inserts with all-plastic helmets. The new Kevlar headgear, which strongly resembles the helmets worn by German troops in the '30s and '40s, weighs about 6 ounces less than the original steel pot. But the 53-ounce replacement is much more bullet-resistant, according to Army testers at Natick, Mass. Du Pont, which makes Kevlar, says more than half the police officers in America wear Kevlar bulletproof clothing. In fact, the Army says the new plastic pot provides at least 25 percent more ballistic protection than the steel helmet. But the new model melts or cracks from extreme heat, so cooking dinner in your headgear will soon be part of military history.

Of course, soldiers firing their weapons will appreciate a helmet that doesn't cover their eyes with every kick of the rifle.



Army's Kevlar plastic helmet (left) will replace the steel pot (right).



DUNE BUGGIES RIDE TO WAR

Dune buggies do a great job of scrambling over rugged terrain just for fun. Realizing that they might do equally well on the battlefield, the U.S. Army is now arming similar vehicles for hit-and-run combat missions. Made by Emerson Electric, the little fat-tired FAVs (for Fast Attack Vehicles) can fire a 30-mm cannon or missile launcher while moving at 80 mph.

MARINE



SuperOutrigger: Smooth sailing in rough seas

Since the early days of civilization, Hawaiian seafarers have been putting outriggers on their canoes to keep them from tipping over. Now a modern Hawaiian inventor, Nathan I. Daniel, has applied the idea to a large, oceangoing craft called a SuperOutrigger. Its elevated hull rides above the waves on a central, main pontoon, counterbalanced by a smaller outrigger pontoon. The result, says Daniel, is a highly stable platform that glides smoothly through heavy seas with virtually no

pitching, rolling or pounding. Besides its tip-proof safety and gentle handling, other advantages are less power-robbing drag compared to a deep displacement hull; simpler, cheaper construction; and more economical operation.

Initially, the SuperOutrigger will be built as a 320-foot-long car/passenger ferry for fast travel over the often rough waters between the Hawaiian Islands. But the basic design will lend itself to other configurations as well, such

as a workboat for servicing offshore oil rigs, a seagoing heliport for search and rescue missions, and a flat-deck freighter for containerized cargo. Smaller versions could also become a supersafe pleasure cruiser or a party boat for deep-sea fishing.

Twin engines, one in the after end of each pontoon, are said to permit much greater maneuverability than a conventional hull because their propellers are set wide apart and are fitted with controllable-pitch blades. For very sharp turns, one propeller can be reversed as a brake, while the other thrusts forward,

AVIATION

Lifesaving collision alarm

Midair collisions, which have killed about 800 since 1970, should soon be a thing of the past. With a new electronic warning system just approved by the FAA, two airliners on a collision course will be able to talk to each other directly through computers and take immediate evasive action without waiting for a ground controller to spot them and issue verbal commands.

Twin radar beacons on the top and bottom of each airliner scan a spherical field of airspace 14 miles in all directions. These signals, interacting with those from transponders, tell on-board computers the heading, range, speed and altitude of each approaching aircraft. (Present radarscopes show only weather patterns, not contacts with other traffic.) The computers then flash instructions to each pilot by means of lighted arrows on a cockpit display, telling him to climb, dive or turn to the right or left.

The new TCAS (for Traffic Alert and Collision-Avoidance System) has been tested successfully at the FAA's Technical Center in Atlantic City, N.J., and is expected to be operational by mid-1984. It will cost about \$50,000 per unit—peanuts compared to the multimillion-dollar price of a commercial transport or military jet. A simpler version, for about \$2,500, will be available for business and personal aircraft.

UMBRELLA-LIKE RADAR COVERAGE EXTENDS 14 MILES IN ALL DIRECTIONS

THREAT AIRCRAFT WITH BEACON TRANSPONDER

TRANSPONDER SIGNAL WARNS PILOT OF AIRLINER

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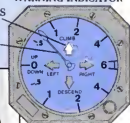
TCAS-EQUIPPED AIRLINER

BELLY-MOUNTED RADAR TRANSMITTER

FLASHING ARROW TELLS PILOT TO CLIMB

VERTICAL SPEED POINTER SHOWS THE RATE OF CLIMB OR DESCENT

COCKPIT WARNING INDICATOR



Close calls (left) won't happen with new anticollision system. Cockpit display (above) warns the pilot to take evasive action.



Editor: Dennis Eskow

Contributors: Sheldon M. Gallager, Jack Hammond, Mort Schultz, Eldonna Fisher, Christopher Swann, Bruce Moss, Bernhard J. Hurwood

TECHNOLOGY UPDATE



PM art: Dean Ellis

allowing the vessel to pivot in its own length much like a tracked Army tank. Duplicate sets of rudders in both the bow and stern also aid maneuverability, eliminating the need for expensive auxiliary bow thrusters.

For added safety, the pontoons are divided into a series of watertight compartments. In case of an accidental rupture, several sections can flood without endangering the craft's buoyancy. A 1/4th-scale test model has already proved seaworthy, and construction of a full-scale prototype is expected to begin later this year.



A manned ADV descends into sea (top); its arms worked from cockpit. An above-sea crew (above) guides unmanned model.

Neptune's 'arms'

They can carry a man 3,000 feet below the surface or send a TV camera down 10,000 feet. Once below, their two robot arms, operated by a diver inside the vehicle or by a crew in an above-surface control room, can work on oil wells. These are the Arms Delivery Vehicles, or ADVs, manufactured by Ocean Engineering International, a Houston-based underwater service company.

The new ADVs are lowered to the job on a 1½-inch steel umbilical cable. Once at depth, horizontal and vertical thrusters can position it delicately. Without a diver, the equipment sees with pan and tilt video cameras operated from the surface.

During actual work, the force-feedback manipulator arms of the diving bell can push, pull, turn, lift and set down heavy objects. The operator inside the bell or on the surface works the arms with a switch designed by General Electric that uses electronically processed data to give the switch the feel of an object that is doing the actual lifting. This gives the operator a feel for how much force the robot arms should exert. The ADVs have two grabber-manipulator arms that can hold a beam steady and lift objects of up to 900 pounds. The ADV, which has been an experimental vehicle until now, is expected to see service in the Texas gulf by the end of this year.



SPY PLANE FOR NATO

The first NATO squadron of Lockheed-built TR-1 spy planes is being delivered to Alconbury, England, this summer. The first six TR-1s of the 35-plane order were

delivered in June, with three more scheduled to arrive by September. The planes cruise at 430 mph at 70,000 feet. They fly in any weather, day or night.



FLAPS UP, DOME DOWN

The latest development in simulated combat flight is the McDonnell Douglas F-15 Eagle simulator. The two-seat cockpit sits under a 40-foot-diameter dome on which training officers can project all sorts of situations from dog-fights to near-ground combat. In addition to training pilots, the simulator is evaluating the F-15's instrumentation for attack-craft duty. That includes electronics to control air-to-air and air-to-ground missiles. The F-15 already is flight-certified with a wide range of advanced-fighter capabilities, including long-range, all-weather radar.



BAD WEATHER GUARANTEED

Airline pilots are flying Boeing 767s in the foulest weather they've ever seen, but it's very safe. With a Smiths Industries weather radar simulator, a pilot can practice flying through a storm that develops with uncanny realistic speed and true foul-weather readings (left) on the simulator's radar screen.

INVENTIONS

Gas from chips

The first machine designed to convert wood chips into high-octane methanol has begun experimental operations at the Solar Energy Research Institute's labs in Boulder, Colo. The methanol could be used as fuel

by utilities, in office buildings and even in cars. The \$1 million machine converts up to a ton of wood chips a day into enough methanol to power and heat a five-story building.

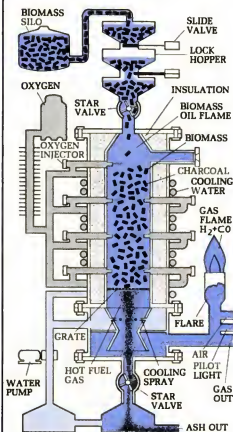
The Oxygen Biomass Gasifier, a creation of two Colorado inventors, Thomas Reed and Michael Graboski, produces a medium-energy (300-BTU) synthesis gas that converts to methanol. By injecting pure oxygen instead of ambient air into the system, the gasifier can convert 99.5 percent of the process's tars and oils into gas.

Wood chips are fed through a silo into the gasifier at temperatures around 1,000° F. A star valve continuously feeds the biomass (chips) into the reactor. The vessel is surrounded by a water-cooling system near the chamber where gas separates from the very hot and pressurized chips. Tars not carried out by the oxygen as vapors move toward a combustion chamber to feed the heating process.

The gasifier is so efficient that the only solid waste is ash. The ash can be used as fertilizer. Now that the experiment has proven successful, a scaled-up version is planned. The Denver-based Methanol Inc. will build a 6 million gallons a year methanol plant sometime next year.



Engineer feeds wood chips into Oxygen Biomass Gasifier. The machine processes up to a ton of chips.



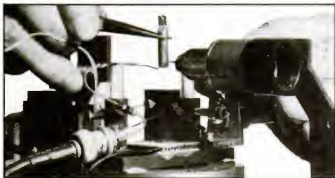
Seeing eye machine

Thousands of patients denied eye surgery because their doctors were afraid it would do no good are now looking forward to restored sight. Using a new Guyton-Minkowski Potential Acuity Meter (PAM), doctors can determine with very high certainty whether removing a cataract or other obstruction will restore sight. The PAM focuses a thin beam of light through any tiny opening (1 mm wide or more) in the cataract. The beam then widens and focuses a standard eye chart on the patient's eye behind the cataract. If the patient can read the chart, surgery is performed. Reports in medical journals indicate the PAM has a near 100 percent diagnostic accuracy.



Device projects eye chart through cataract to determine whether surgery will work.

Light talk



Telephone companies already have replaced some electric telephone wires with fiber optics that use light to carry a message. But a new invention from Bell Labs may advance fiber optics beyond anyone's wildest dreams. Bell officials say their new laser switch may herald the coming of a computer that works on light instead of electricity. Officials showed that the sharply tunable Bell laser can pass through a fiber (above) and turn a switch on and off. It could lead to the most powerful computer chips ever by the end of the 1990s.

Spray-on housing



Adobe houses are popular in the Southwest because they're cheap to build and they insulate well against the extremes of the desert. An inch of adobe has an R-rating of 3.3. But adobe weathers easily and is difficult to maintain. Enter Tucson architect Robert Barnes and his new invention—Ablobe. A mixture of clay, straw and polymer material, the Ablobe is liquefied and can be sprayed onto a building. Thus, a cracked adobe wall or weathered adobe brick can now be revived with the treatment.

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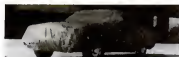
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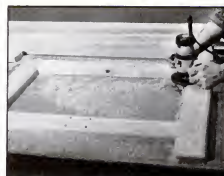
PM'S PICKS FOR PICNICS

(Continued from page 122)

rounding over is complete, finish-sand all parts.

Reassemble the leg units, rails and stretchers with glue and screws. Set the partially completed table and benches right side up and begin laying out the slat positions. Find the exact center of a slat and mark it at both ends. Align those marks with layout marks you've made at the centers of the

(Please turn to page 132)



Round over corners before final assembly. Move router in the direction opposite the bit's rotation for clean cuts.



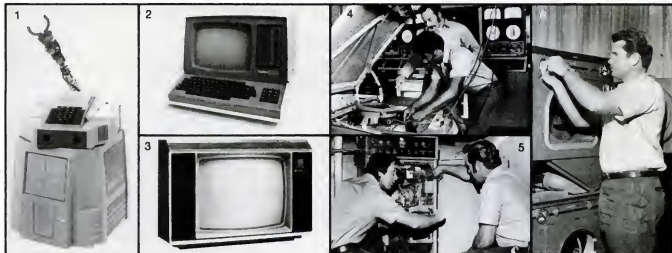
Counterbore tabletop slats on drill press, lay them in place on ledgers with spacer blocks and bore screw body pilots.

MATERIALS LIST— DESIGNER PATIO BENCH*

Key No.	Size and description (use)
AA	2 1 1/4" x 2 1/2" x 12 1/2" ash (inner end rail)
BB	4 1 1/4" x 3" x 18" ash (leg)
CC	2 1 1/4" x 2" x 12 1/2" ash (lower end rail)
DD	2 1 1/4" x 2 1/2" x 51 1/2" ash (inner side rail)
EE	2 1 1/4" x 3" x 51 1/2" ash (legder)
FF	1 1/4" x 2" x 51 1/2" ash (stretchers)
GG	2 1 1/4" x 2 1/2" x 13 1/4" ash (outer end rail)
HH	8 1 1/4" x 4 1/4" x 10 1/4" ash (slat)
II	2 1 1/4" x 4 1/4" x 10 1/4" ash (end slat)
JJ	2 1 1/4" x 2 1/2" x 56" ash (outer side rail)
KK	8 3/4" x 3" lagscrew and washer
LL	4 3" No. 14 ft screw
MM	40 2" No. 14 ft screw
NN	8 1 3/4" No. 14 ft screw
OO	52 1/4"-dia. x 3/4" walnut plugs
PP	1 24" x 55" fabric (bench cover)

* The number of pieces are based on requirements for one bench. Double the quantities to build two benches.

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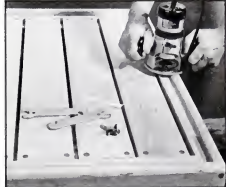
PM'S PICKS FOR PICNICS

(Continued from page 128)

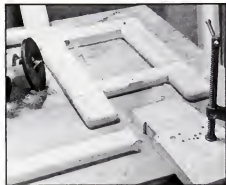
side rails, laying the slat on the ledgers. Set the remaining slats in place on either side of the center slat, inserting temporary spacer blocks of equal size between them. We've specified widths for slats, but those may have to be



After screwing in slats, fill recesses with walnut plugs and sand them flush with the surface using a belt sander.



Attach side rails last. Round over top outside corner with a 1/4-in.-rad. bit, inside corner with a 1/4-in.-rad. bit.



Construction of the benches is similar to table. Use a simple jig like the one above to stop round at stretcher ends.

altered slightly to achieve a uniform pattern.

When the slat layout is complete, mark each slat in sequence, indicating its correct position, then remove them. Lay out and bore pilot holes and plug recesses in the slats. Restore them to their correct positions and bore pilot holes and screw shank diameter holes

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through and into the ledgers. The next step is to glue and screw the slats in place.

Glue the walnut plugs in to conceal the screws in the slats. Use a belt sander to flush the plugs with the surface, then finish-sand the slats.

Next, fit the outer rails on the table and benches. You should note that the outer rail details for the table and bench differ slightly. The outer rails of the table are $\frac{1}{2}$ in. wider than those for the benches and must be attached with their top edges $\frac{1}{2}$ in. higher than the slat surfaces. On the benches, the outer rails are set flush with the benchtops.

The outer end rails are attached first with a $\frac{1}{2}$ -in. overlap at the sides of the table. The outer side rails are screwed

$\frac{1}{2}$ -in. radius bit. Find the exact center of the tabletop by lightly drawing an X from the corners. Use that point as the center for a $1\frac{1}{2}$ -in. hole which is bored through the top.

After boring the hole for the umbrella, suspend a plumb bob through it with the bob dangling just above the ground in between the double stretchers. Make sure the tabletop is level and the plumb line is hanging from the exact center of the hole.

Use a square to draw a line that intersects with the plumb line across the top of the stretchers. This is the centerline for the length of PVC pipe which will be

used as a sleeve for the umbrella post.

Prebore two spacer blocks (G) to enable a 10d nail to slide in and out easily. Apply glue to the inside of the stretchers where the blocks will be positioned. Then slide the blocks into place. Bore and counterbore for screws and plugs on the outside faces of the stretchers. Fasten the blocks with screws, glue in the plugs and sand them flush. Insert a 10d nail through the holes in the blocks and slip in the PVC sleeve. Finish the table and benches with at least three coats of exterior varnish.

FM



Rails differ for table and benches. On table, they're offset $\frac{1}{2}$ in. above top. On benches, they're flush with seat.

into the outer end rails, leaving a $\frac{1}{2}$ -in. space between the inner and outer side rails. This detail will allow the tablecloth and bench covers to be tucked through the space, keeping the covers secure.

The top and bottom corner edges of the outer rails are rounded over with a $\frac{1}{2}$ -in.-radius router bit. The outside top corner of the inner side rail should be treated in the same way. The inside top corner of the outer side rails should be rounded over with a $\frac{1}{4}$ -in.-radius solid pilot bit since there is insufficient clearance for a bit with a ball-bearing pilot. The corners at the ends of the outer side rails should be rounded over with a

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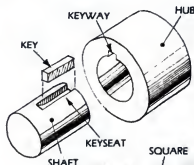
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How To Talk METALWORKING

Newcomers to metalworking are often confused by the vocabulary they must learn. Keyed assemblies, for instance, are frequently found in mechanical drive systems. But the words used to identify the parts of a keyed assembly are often confused or used improperly. To understand what each of these terms means, you should acquaint yourself with the various parts of a keyed assembly and the varied shapes for keys that are commonly used. The origin of some metalworking terms is obscure, but the words here are commonly recognized by all metalworkers.—Edward G. Hoffman

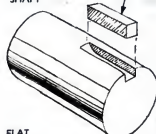
Keyed assembly

This is a generic term used to describe a system of components that fits together in a particular way. A typical keyed assembly is composed of three parts: 1. a *hub*, which is a hollow outer casing; 2. a *shaft*, which is usually cylindrical and fits inside the hub; and 3. a *key*, which fits into recesses in the hub and shaft for an interlocking. A recess cut on the inside hub wall to accommodate the key is called a *keyway*. Its counterpart, cut on the outside of the shaft, is called a *keyseat*.



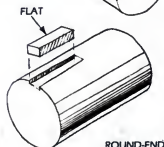
Square key

Square refers to the cross-sectional shape for keys that are commonly used in hubs mounted on the ends of shafts, unless the hub wall is too thin to accommodate depth of the key.



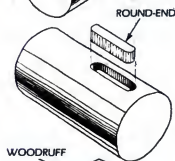
Flat key

Flat describes the rectangular cross section of keys frequently used in thin hubs, or on shafts with center holes where a shallow keyseat is necessary.



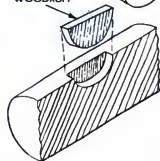
Round-end key

Usually longer than square and flat keys, a *round-end key* is located typically in the center of a shaft where it is subjected to high torque.



Woodruff key

This type of key has a semicircular shape and its ends are not visible from the outside of the keyed assembly. It is commonly found in small mechanisms such as automobile generators and alternators in which torque is limited.



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Driving The VW Quantum GL5

Decked out, Volkswagen's five-cylinder flagship is a \$15,000 experience.

BY DON FULLER

Once again, Volkswagen has taken a step up the ladder of automotive society's pecking order. VW's continuing romance with Audi territory has been steady and predictable. Jim Fuller, vice-president in charge of the Volkswagen division, will tell you that it's only a corporate attempt to fill all possible price slots. But the five-cylinder version of the Quantum, named the GL5, has VW executives whispering quietly and hopefully of those buyers who might be considering a BMW or Mercedes. While it's folly that VW is even thinking about selling to those with their eyes full of spinning propellers and three-pointed stars, the truth is that this version of the People's Car is now only for those Volks with about 14 grand or so to spend on a Wagen.

The distance from Wolfsburg to Stuttgart is shortening.

The upper crustiness of this Volkswagen, though, to compete with Mer-

cedes, BMW or Audi, is apparent from first glance. The styling is contemporary Prussian—conservative in shape, devoid of detail frills, attractive in a refined and comforting way, finished with just enough German chrome to make it look expensive. This same shape has been on German cars for years. It's intended not necessarily to excite, but to reassure.

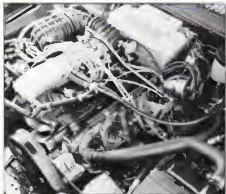
Likewise, the interior is exceptionally nice. The headliner is attractively molded and covered in a patterned fabric, with sun visors and interior lamp neatly integrated into the whole. The seats have a reserved herringbone cloth

that feels rich and looks stylish without being gaudy. And the doors are artistically sculpted in the coordination of the armrest, pull handle and requisite storage pocket. Only the dash is bland. But it's at least clean and informative, with lots of bins to stow whatever people carry in their cars. The sole tackiness is the way unused window crank and power mirror holes are covered with plastic buttons, instead of giving those particular cars so equipped, door panels all their own without holes in the fabric. If the customer pays more, it seems reasonable the car should look at

(Please turn to page 142)



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Flush side glass, rain grooves in the roof and smooth flanks, with no fender flares, contribute to Audi's slipperiness.

PM photos: Vic Huber

Driving The New Audi 5000S

One look tells you this is the most aerodynamic sedan on the road today.

BY GARY WITZENBURG
DETROIT AUTO EDITOR

Most automotive superlatives carry asterisks. This or that car is best at one thing or another within a given set of parameters. Your results may differ.

Arguments over such claims are endless. Indisputable proof is rare. Direct comparisons can vary from one test to the next. One car may be quicker than another apparently identical vehicle. Or have better fuel mileage under certain conditions. Or better braking or handling, depending on the test conditions.

But one thing is certain about Audi's sleek new 5000S: It is the world's most aerodynamic sedan. Period. No arguments. No asterisks.

Well, maybe one small asterisk. Make that the most aerodynamic pro-

duction sedan. One-off specials, prototypes, design exercises and concept cars don't count. Ford claims a startling drag coefficient (Cd) of 0.15 for its Probe IV aero show car, for example. But that's far from production.

The U.S. Audi 5000S's Cd is 0.33. That compares to the new Ford Thunderbird's 0.35, the '84 Corvette's 0.34, the Pontiac Firebird Trans Am's 0.312 and the special Daytona 500 Pace Car Trans Am's 0.306. But those are all sports cars and sport coupes. No other sedan on the market even comes close.

The European base model (called Audi 100 there), with flush headlight covers, smaller bumpers and tires, no right-side mirror and less cooling air intake for its smaller engine, parts the air at an amazing 0.30. That makes it the world's slipperiest mass-produced car of any kind, including sports cars. We know that comparing Cd's from different wind tunnels with different mathematical fudge factors can be misleading. But as the aerodynamic science advances each year, the compari-

(Please turn to page 140)



The console in the Audi 5000S is packed with neat features: Electronic climate control is pushbutton-activated. The digital readout in Fahrenheit or Centigrade gives the temperature inside or outside the car. The driver's side power window is lowered completely by one tap on the control—there's no need to hold down the switch. In order to stop the window part of the way down, you merely have to give the switch an upward tap.

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DRIVING THE NEW AUDI

(Continued from page 138)

sons seem to grow more valid. Audi actually developed its new 5000S body in six different European wind tunnels, taking more than 1,000 test-hours over five years to do it. Their engineers say the average result was slightly under 0.30.

They also cite an independent test conducted in Volkswagen's wind tunnel in Germany of 247 different cars from all over the world. This ambitious project found a mean Cd of about 0.42 through early '82 models, verified Audi's claim of 0.30 for its new European 100 and rated only one unspecified non-European sports car—probably the U.S. Trans Am—as close as 0.32.

How did Audi designers achieve such an incredibly slippery sedan? Mostly through careful attention to detail, plus a touch of innovation. Definitely not by going to a radical banana shape, full fender skirts or such potentially expensive trickery as self-lowering spoilers and suspension.

The only really unique exterior body feature on the car, in fact, is a new flush side-window design with retractable curved glass riding outside its seals. Each window is held in place by a pin that bolts through the glass and slides

up and down in a slot in the door frame.

Though any automotive shape must be a series of compromises, no stone was left unturned in striving for minimum drag. The front end is carefully shaped to divert most air over the car instead of underneath and around the sides. The 60.5° windshield rake, says Audi, proved to be the steepest angle that retained acceptable light refraction, visibility, raindrop accumulation and interior heating characteristics. The rear window angle (64°) and rear deck height and length were careful compromises among conflicting considerations—low drag, aesthetics and such practical factors as rear visibility and loading ease.

Front and rear roof pillar designs provide low drag without reducing crosswind stability. Flush windshield and backlight (both bonded in place), the unique flush side windows and a pair of shallow grooves in the roof instead of conventional rain gutters complete the ultraslippery upper design. A modest integrated air dam and aerodynamically shaped rear axle, fuel tank and lower rear-end panel smooth airflow under the car, while lipless wheel openings and flush alloy wheels give unimpeded flow along the body sides. Other small but important contri-

butions come from such items as aerodynamic outside mirrors and airfoils on the windshield wiper blades.

Okay, so the '84 Audi 5000S, which is selling for \$15,800, is the world's most aerodynamic sedan. So what? What does that mean to the American car buyer contending with a 55-mph speed limit and radar-happy enforcement?

First off, the superslippery shape buys you a better performance/economy compromise. With the same 100-hp, 2.1-liter five-cylinder engine and closer, more performance-oriented gearing in its five-speed transaxle, the standard '84 5000S's EPA ratings are 22 mpg city and 35 highway—nearly identical to last year's five-speed 5000. However, 0-to-60 acceleration is an impressive 1.2 seconds quicker at 11 seconds flat, and top speed is up 2 mph to 109. So, better performance at little or no sacrifice in fuel mileage is the new 5000S's rationale for being.

The optional three-speed automatic yields 20/28 EPA mpg (up 1 mpg from '83) with equivalent acceleration and 4 mph higher top speed at 108 mph. The real-life highway economy advantage should be even more pronounced, and cruising range with the 5000S's big 21-gal. fuel tank is 600 miles with the automatic and 700 with the five-speed.

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Super-aero also buys you isolation-chamber quiet in the cabin at speed, plus improved cooling airflow and less dirt deposits on the windows and tail-lamps. One thing better aero doesn't do is improve the car's low-speed ride or handling. Audi engineers did that with some judicious suspension development. But it does reduce aerodynamic lift, thereby increasing traction at highway speed. Sidewind stability is also improved.

The new 5000S is about 4 in. longer (192.7 in.), 2 in. wider (71.4 in.) and 175 pounds heavier (2,878 pounds) than the car it replaces, and sits on a marginally longer 105.8-in. wheelbase. Interior room is up roughly an inch in each dimension compared to what was already a highly comfortable and space-efficient five-passenger cabin. Trunk space is increased 17 percent to 17.5 cu. ft.

Improved electronics

The willing fuel-injected overhead-cam five-cylinder engine has improved electronics, including a deceleration fuel cutoff and idle speed control plus new no-maintenance hydraulic lifters for '84.

A new central hydraulic system provides steering and brake assist. Charged by a single hydraulic pump, this system draws little engine power and gives a firm, precise feel to both the Audi's rack-and-pinion steering and its disc/drum brakes. In the latter case, especially, there's a large improvement over Audi's previous spongy-feeling vacuum-assisted brakes.

Except for the engine's throaty roar under acceleration, the car is extremely quiet inside, even with its clever (optional) two-way sunroof cracked open. Performance is brisk, primarily due to the five-speed's closer-ratio gearing, though an automatic-equipped car that we tried briefly seemed underpowered (about 13 seconds 0-60) on hilly roads. The driver's seat and driving position are excellent for our taste, and both handling and braking through the twisty bits are superb.

German interior designers are masters of instrument and control layout, and Audi's group is no exception. Lights, wipers, turn signals, cruise control and emergency flashers all are operable without removing either hand from the wheel, thanks to four fingertip-reach stalks. Infinite backrest angle adjusters for both front buckets are on the inside, between the seats, instead of on the outside against the doors. The electronic climate control (standard) and the excellent cassette stereo (optional) are easy to decipher and operate, and the standard power window controls are conveniently located below

(Please turn to page 142)

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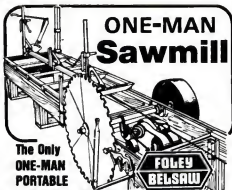
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DRIVING THE QUANTUM

(Continued from page 138)

least as nice—certainly not any worse.

All of this creates an inviting driving and riding environment. It's impossible not to be comfortable, both physically and spiritually. The seats cradle your body, the ambience reassures your mind. All is okay in here.

All is okay underneath, too. The car rides on deep coil springs at all four corners with supple shock valving. The total impression of ride and handling is about what we take for granted in good sedans these days without giving enough credit to the hard work involved. The GL5 delivers fine control, precise steering, excellent directional stability, sharp response and enough feedback to transmit information without giving you every grisly detail. Only one fly in this ointment. Many German sedans are becoming more like French



GL5 models come very well equipped for between \$13,000 and \$14,000. Major options—A/C, power sunroof and metallic paint—take it to \$15,000.

sedans and the Quantum is no exception. This means generous suspension travel to enhance the smooth ride. This also means lots of body roll when cornering. In the tradeoff, much of the tautness in feel is lost, if not the actual fine result in behavior. But most drivers are probably concerned more with smooth ride than tail handling. So it seems like a fair deal.

The new deal about this car, though, is the five-cylinder engine, which has been under the hoods of various Audis for years. Little changed along the way, its 2,144 cc makes 100 hp at 5,100 rpm and 112.4 ft.-lb. of torque at 3,000. Obviously, they stuck it in the Quantum to give the car better performance. We got 13.6 seconds for 0-to-60 mph runs for a five-speed four-cylinder, and 12.6 for the automatic five-cylinder GL5. And since, with the larger engine and more equipment, the five-cylinder weighs about 150 pounds more, that's a useful improvement.

Concern about increased fuel consumption is unfounded. EPA estimates for the Four with automatic are 23 mpg city, 30 highway, while the GL5 will get the government's seal of approval for 20 city, 29 highway—really, not much loss. For more economy in the same

body shell, the four-cylinder five-speed has numbers of 29 and 42.

If the goal of a five is to give an approximation of six-cylinder smoothness with an approximation of four-cylinder economy, Audi—it's Audi's engine, after all—certainly made it. To most passengers, it will be clear there are more than four cylinders under the hood. But exactly how many is harder to detect. Even at idle, the engine is smooth and even, though under full throttle acceleration, the engine emits a throaty roar.

Not that this is a hot rod. After all, there are only 100 hp in a car weighing close to a ton and a half with driver and fuel. It takes time to get itself rolling, and passing and on-ramps need full throttle and the resultant automatic downshift for enough punch to get up to speed. It is also no mountain flattener. But characteristic of European cars in general and German ones in particular, it has a very long-legged feel to it. Once up to speed, it runs in smooth and long strides that cover the maximum distance with an apparent minimum of effort. Maintaining the speed, once achieved, is much easier than getting there in the first place. It's a nice cruiser.

The only thing not particularly exciting about the Quantum GL5 is just that. It isn't particularly exciting. It is, in fact, Exhibit A that VW is going the way with many of its products that much of the rest of the world's car industry has followed—trying to make it appeal to as many buyers as possible. But the Quantum gets diluted in the process. That isn't exactly what got VW there in the first place, but it's the most obvious path to increased market share, say the marketing moguls. Maybe the Rabbit GTI is Exhibit B that individuality still exists somewhere at VW.

PM

DRIVING THE NEW AUDI

(Continued from page 141)

the radio. Two neat innovations are a stereo headphone jack for rear passengers and a switch that makes the driver's side window go all the way up or down with a single touch.

A few days of driving a well-equipped five-speed 5000S on both freeways and twisty two-lanes in Southern California left us impressed. We loved the original U.S. 5000 when we drove it in 1977 (see *Driving The Five-Cylinder Audi*, page 106, Nov. '77), and we like this new one even better. The original has been a target at which other carmakers have aimed in developing their own mid-sized, mid-priced, front-drive luxury sedans. This sleek, sexy new one raises the state of that art a whole bunch more.

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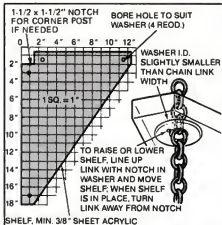
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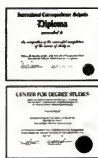
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1 Million of the World's Slimmest Calculator/Watches To Be Sold For Only \$10 Apiece In A Mammoth Publicity Drive

NEW YORK—One million of the world's slimmest, famous "micro-chip" quartz calculator/watches will be sold as part of a publicity campaign for only \$10 apiece to the first one million persons who apply in writing to the company before Midnight, Oct. 30, 1983.

These are the same nationally publicized LCD Quartz "micro-chip" calculator/watches to be featured in *The New York Times*, *Cosmopolitan*, *Playboy* and other leading publications. The slimmest calculator/watches in the world, they are so powerful they never need winding, and accurate to within seconds per month.

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These famous LCD quartz calculator/watches will not be sold at this price by the company in any store. To obtain one at this price, apply in writing to the com-

pany address (below) before Midnight, October 30, 1983.

Each calculator/watch carries a full one-year money-back guarantee and will be replaced by the company, free of charge, if it ever fails to function.

There is a limit of two (2) watches per address at this price, but requests which are mailed early enough (before Oct. 25) are permitted to order up to 5 watches.

To apply for an LCD quartz calculator/watch, mail your name and address *and this original printed notice* together with \$10 for each watch desired. Add only \$2 shipping and handling no matter how many watches you are requesting. Mail to: **Abernathy & Closther, Calculator/Watch, Dept. 114-8, Box 1735, Hicksville, New York 11802.**

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Box: Less than 0.5 mg. "tar", 0.05 mg. nicotine; Menthol: Less than 0.5 mg. "tar", 0.1 mg. nicotine;
Soft Pack and 100's Box: 1 mg. "tar", 0.1 mg. nicotine; 100's Soft Pack and 100's Menthol: 4 mg. "tar", 0.4 mg. nicotine;
120's: 6 mg. "tar", 0.6 mg. nicotine av. per cigarette, FTC Report Mar. '83.